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**INTERIM REPORT**

**March 2, 1993**

**FOR**

**BIOVENTING FIELD INITIATIVE**

**AT**

**NEWARK AIR FORCE BASE, OHIO**

**to**

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**INTERIM REPORT**  
**FOR**  
**BIOVENTING FIELD INITIATIVE**  
**AT**  
**NEWARK AIR FORCE BASE, OHIO**

**1.0 INTRODUCTION**

This report describes the activities conducted at three sites at Newark Air Force Base (AFB), Ohio, as part of the Bioventing Field Initiative for the U.S. Air Force Center for Environmental Excellence (AFCEE) and the Environmental Quality Directorate of the Air Force Armstrong Laboratory. This report summarizes the results from the first phase of the study, which includes a soil gas survey, air permeability test, in situ respiration test, and installation of bioventing systems. The specific objectives of this task are described in the following section. The test sites at the base are discussed individually, followed by a description of site activities at the background area.

**1.1 Objectives**

The purpose of these field test methods is to measure the soil gas permeability and microbial activity at three contaminated sites and to evaluate the potential application of the bioventing technology to remediate the sites. The specific test objectives are stated below.

- A small-scale soil gas survey will be conducted to identify an appropriate location for installation of the bioventing system at each site. Soil gas from the candidate sites should exhibit relatively high total petroleum hydrocarbon (TPH) concentrations, relatively low oxygen concentrations, and relatively high carbon dioxide concentrations. An uncontaminated background location also will be identified.
- The soil gas permeability of the soil and the air vent (well) radius of influence will be determined for each site. These will require air to be withdrawn or injected for approximately 8 hours at vent wells located in contaminated soils. Pressure changes will be monitored in an array of monitoring points.

- Immediately following the soil gas permeability test, an in situ respiration test will be conducted at each site. Air will be injected into selected monitoring points to aerate the soils. The in situ oxygen utilization and carbon dioxide production rates will be measured.
- Using the data from the soil gas permeability and in situ respiration tests, an air injection/withdrawal rate will be determined for use in the bioventing test at each site. A blower will be selected, installed, and operated for 6 to 12 months, and periodic measurements of the soil gas composition will be made to evaluate the long-term effectiveness of bioventing.

## 1.2 Site Description

Three sites were initially chosen for the bioventing initiative at Newark AFB, Ohio. A schematic diagram of the base is shown in Figure 1. The dashed line on the map represents the direction from the main gate to each test site. Summaries of the descriptions of each site are presented in the following sections. A detailed description of the test sites is provided in the Test Plan in Appendix A.

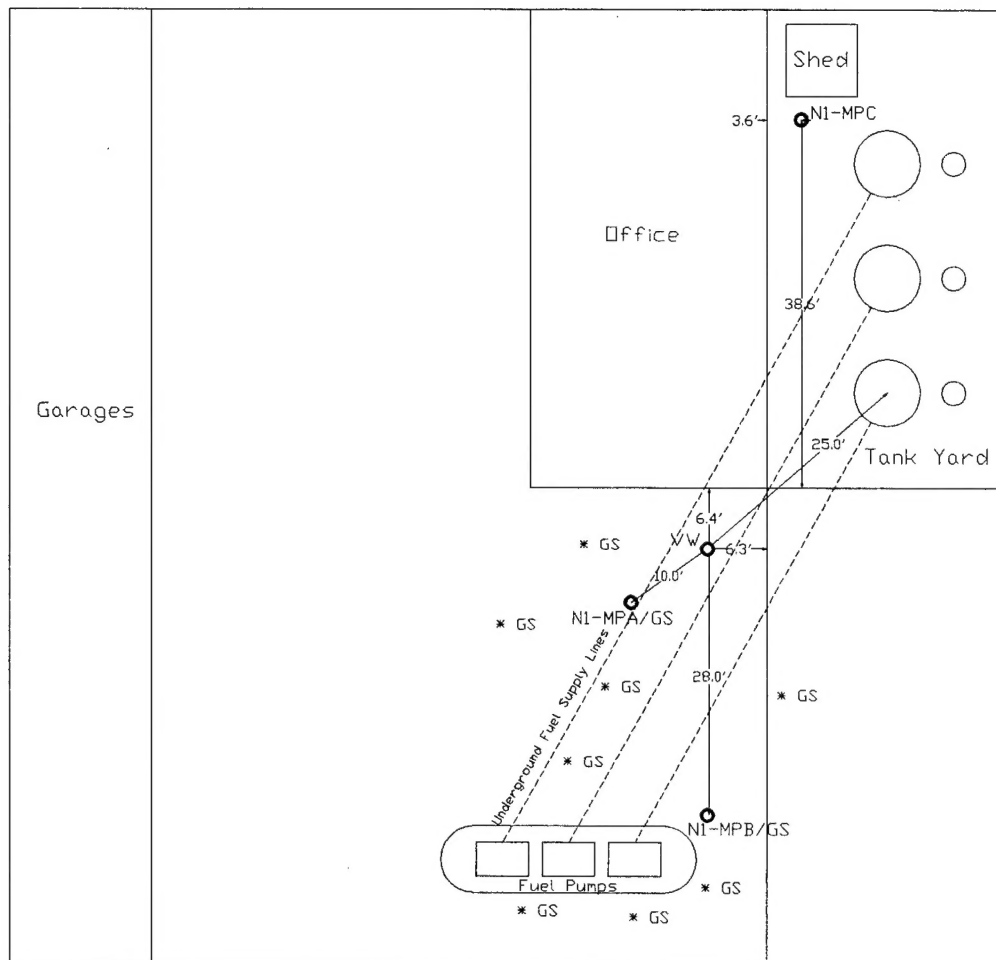
### 1.2.1 Facility 27

Facility 27 (Site N1 on Figure 1; the base motor pool) has three fiberglass underground storage tanks (1,000 gallons unleaded gasoline, 4,000 gallons unleaded gasoline, and 4,000 gallons diesel). The site is an active fuel dispensing facility. Site characterization data have indicated there is soil contaminated with petroleum hydrocarbons in the tank cavity and in the supply line backfill. Figure 2 is a schematic diagram of Facility 27.

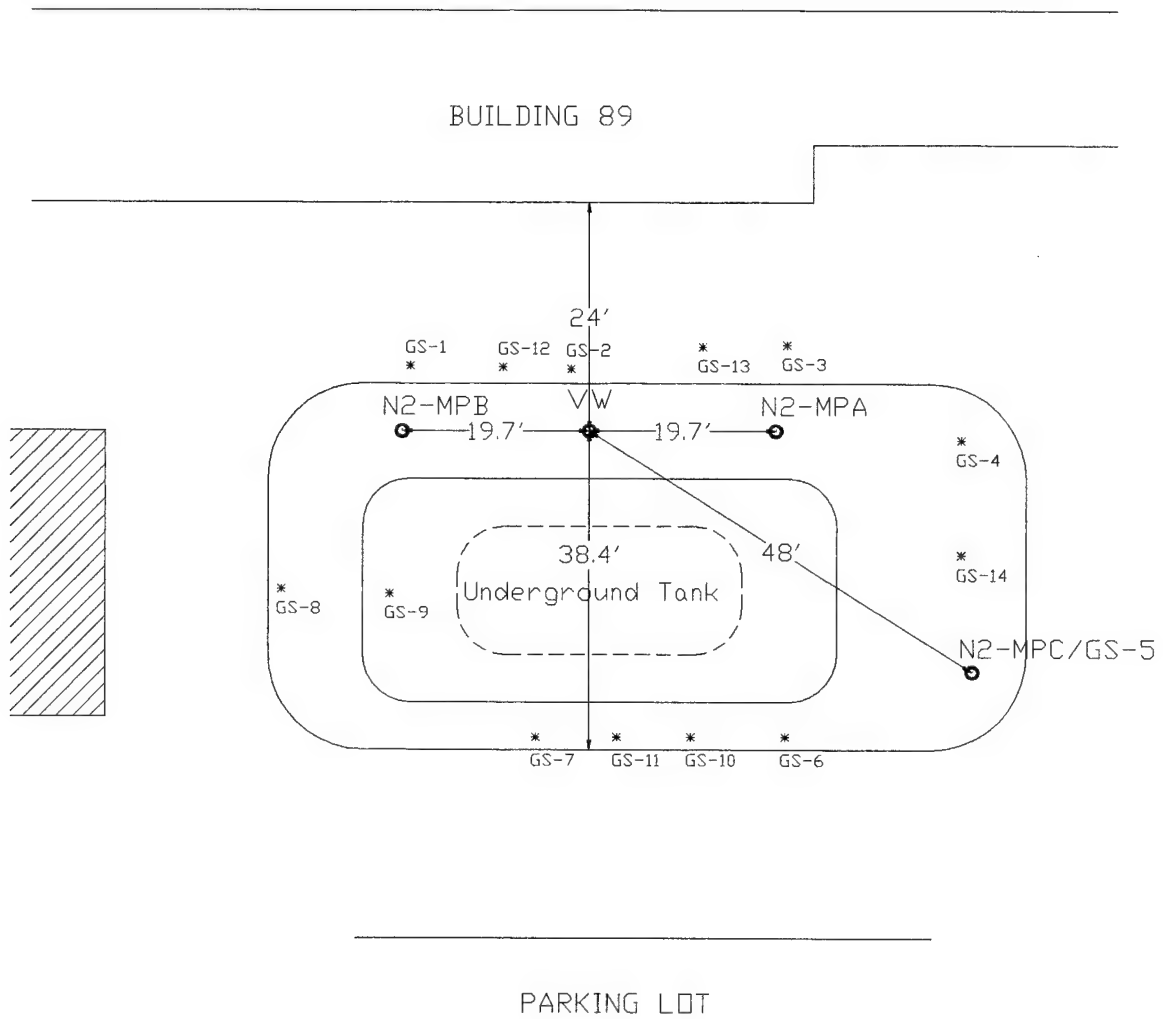
### 1.2.2 Facility 89

Facility 89 is the site of a 20,000 gallon diesel tank (Site N2 on Figure 1). The site is an active fuel dispensing facility. Site characterization data have indicated there is soil contaminated with petroleum hydrocarbons in the tank cavity. Figure 3 is a schematic diagram of Facility 89.

**Figure 1. Schematic Diagram of Newark AFB**



**Figure 2. Schematic Diagram of Facility 27 at Newark AFB (GS - Soil Gas Survey Point; MP - Monitoring Point)**



**Figure 3. Schematic Diagram of Facility 89 at Newark AFB (GS - Soil Gas Survey Point; MP - Monitoring Point)**

### **1.2.3 Facility 14**

Facility 14 is the previous site of a #2 diesel fuel underground storage tank with a capacity of approximately 2,500 gallons (Site N3 on Figure 1). Soil samples have shown contamination with concentrations of TPH ranging from 112 to 322 mg/kg at depths of 5 to 10 feet. A schematic diagram of Facility 14 is shown in Figure 4.

## **2.0 FACILITY 27**

### **2.1 Chronology of Events and Site Activities**

#### **2.1.1 Groundwater Measurements**

One groundwater monitoring well was measured at Facility 27. The groundwater level was recorded at 8.65 feet.

#### **2.1.2 Soil Gas Survey**

A site deemed suitable for the bioventing demonstration should have soil gas characteristics of low oxygen, high carbon dioxide, and high TPH. This composition of soil gas would indicate that oxygen-limiting conditions for microbial activity are present and that the introduction of air may enhance biodegradation of TPH.

A limited soil gas survey was conducted on July 27, 1992 to locate a suitable test area at Facility 27. Soil gases were sampled by driving a 5/8-inch-diameter stainless steel probe into the soil with a hammer drill. Soil gas was withdrawn with a vacuum pump and analyzed for oxygen, carbon dioxide, and TPH.

Measurements of oxygen and carbon dioxide in the soil gas were made with a GasTech Model 32530X with oxygen and carbon dioxide ranges of 0 to 25%. The analyzer was calibrated daily against atmospheric oxygen, atmospheric carbon dioxide, a 10% oxygen calibration standard, and a 5% carbon dioxide calibration standard. TPH was measured with a GasTech Trace Techtor with



# Facility 14

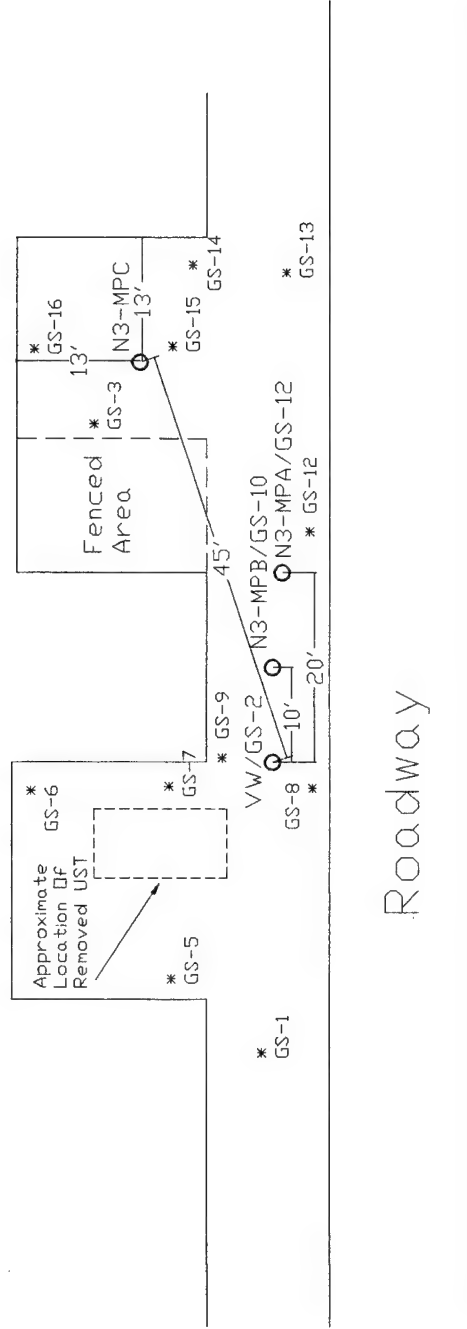


Figure 4. Schematic Diagram of Facility 14 at Newark AFB (GS - Soil Gas Survey Point; MP - Monitoring Point)

Table 1. Initial Soil Gas Composition at Facility 27

Soil Gas Survey Point	Depth (ft)	Oxygen (%)	Carbon Dioxide (%)	TPH (ppm)
GS-1	2.0	9.0	12.5	4,000
	3.0	19.0	2.3	150
	4.0	NM	NM	NM
GS-2	2.5	19.2	NM	8,000
GS-3	2.5	NM	NM	NM
GS-4	2.5	NM	NM	NM
GS-5	2.5	NM	NM	NM
GS-6	2.5	8.5	5.5	200
	3.5	7.5	6.0	210
	5.0	7.0	6.5	210
GS-7	2.5	NM	NM	NM
	5.0	3.1	8.6	290
	7.5	2.2	8.9	300

NM Not measurable due to inability to collect soil gas sample resulting from low soil gas permeability.

TPH ranges from 0 to 100, 0 to 1,000, and 0 to 10,000 ppm. The GasTech Trace Techtor was calibrated daily against a 4,200-ppm hexane standard.

Soil borings were advanced during previous site characterization activities to depths of approximately 25 feet. No groundwater was encountered at this site at this depth.

The soil gas probes were driven to depths ranging from 2.0 to 7.5 feet at several locations at Facility 27. Table 1 provides the initial concentrations of oxygen, carbon dioxide, and TPH for the various locations at Facility 27. Oxygen concentrations varied from 2.2 to 21%, whereas TPH concentrations ranged from 150 up to 8,000 ppm. These results indicate that, although not all areas of the site are oxygen-limited, some areas may respond to bioventing.

### **2.1.3 Vent Well, Monitoring Point, and Thermocouple Installation**

On July 29, 1992, the vent well (VW) and three monitoring points (MPs) were installed at Facility 27, and collection of soil samples for analyses was begun. The monitoring points were labeled N1-MPA, N1-MPB, and N1-MPC. The locations of the vent well and monitoring points are shown in Figure 2. A cross section of the vent well and monitoring points showing site lithology and construction detail is shown in Figure 5.

The vent well was installed at a depth of 11.2 feet into an 8-inch-diameter borehole. The vent well consisted of Schedule 40 2-inch-diameter polyvinyl chloride (PVC) piping with 6 feet of ten-slot screen. The annular space corresponding to the screened area of the well was filled with silica sand; the annular space above the screened interval was filled with bentonite to prevent short-circuiting of air to or from the surface.

Soil gas probes consisted of 1/4-inch tubing with a 1-inch-diameter, 6-inch screened area. The annular space corresponding to the screened area was filled with silica sand. The interval between the screened areas was filled with bentonite, as was the annular space from the shallowest monitoring point to the ground surface. The monitoring points were installed at depths as follows:

- Monitoring point N1-MPA was installed at a depth of 9.5' into an 8-inch-diameter borehole. The monitoring point was screened to three depths: 4.0', 6.5', and 9.0'.
- Monitoring point N1-MPB was installed at a depth of 10.0' into an 8-inch-diameter borehole. The monitoring point was screened to three depths: 4.0', 6.5', and 9.0'.

MPC

MPB

MPA

Vent Well

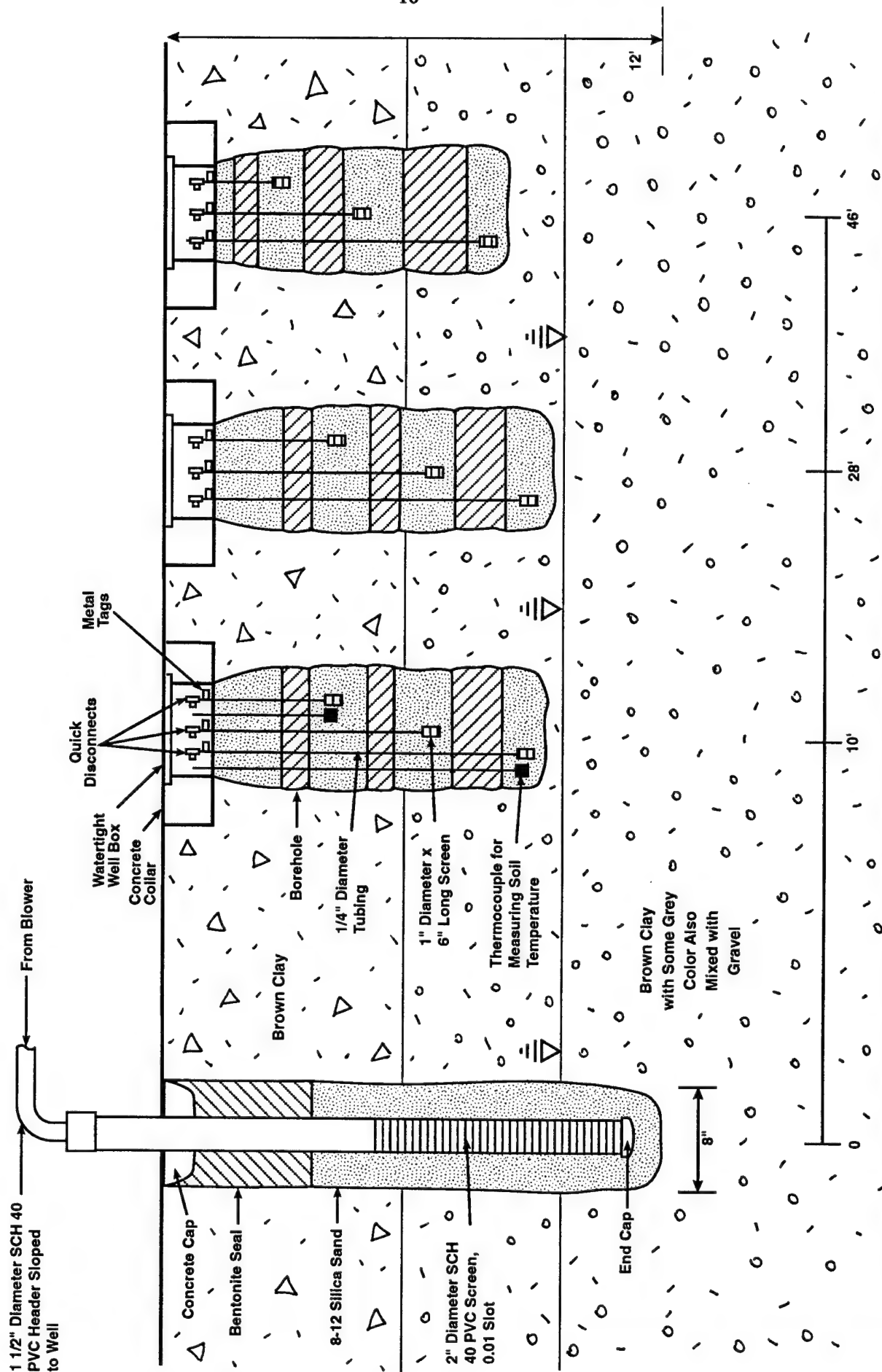


Figure 5. Cross Section of Vent Well and Monitoring Points at Facility 27 Showing Site Lithology and Construction Detail

- Monitoring point N1-MPC was installed at a depth of 8.5' into an 8-inch-diameter borehole. The monitoring point was screened to three depths: 2.7', 5', and 8.0'.

A Type J thermocouple was installed with monitoring points N1-MPA-4.0' and N1-MPA-9.0'.

#### **2.1.4 Soil and Soil Gas Sampling and Analyses**

Soil boring samples were collected from depths of 4.0 feet to 4.5 feet and from 8.0 feet to 9.0 feet from the Facility 27 monitoring point A borehole and were labeled N1-A-4'-4.5' and N1-A-8'-9'. The samples were sent under chain of custody to Engineering-Science, Inc., Berkeley Laboratory for analyses of benzene, toluene, ethylbenzene, and xylenes (BTEX); TPH; alkalinity; moisture content; pH; iron; total phosphorous; total Kjeldahl nitrogen; and particle size analysis. Soil gas samples were collected from monitoring points N1-MPA and N1-MPC and from the vent well. These samples were labeled N1-A-6.5, N1-C-8', and N1-V-11.2. These samples were sent under chain of custody to Air Toxics, Ltd., in Rancho Cordova, California, for analyses of BTEX and TPH.

#### **2.1.5 Soil Gas Permeability and Radius of Influence**

A detailed description of the method for conducting a soil gas permeability test, including equations to compute  $k$ , the soil gas permeability, is described in the Test Plan and Technical Protocol (Hinchee et al., 1992).

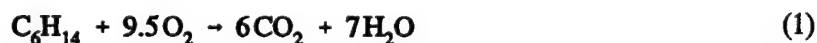
The monitoring points at Facility 27 were allowed to set up for 24 hours prior to air injection. A portable 1-horsepower (HP) explosion-proof positive displacement blower unit was used to inject air. After air injection was initiated, pressure readings were taken approximately every 1 to 2 minutes for the first hour, then approximately every 10 minutes for the following hour. The Hyperventilate™ computer model was used to calculate the soil gas permeability.

### 2.1.6 In Situ Respiration Test

Immediately following the soil gas permeability test at Facility 27, air containing approximately 1% helium was injected into the soil for approximately 24 hours beginning on August 11, 1992. Air was injected concurrently into the background monitoring well to measure the natural biodegradation of organic material in the soil. The setup for the in situ respiration test was as described in the Test Plan and Technical Protocol (Hinchee et al., 1992). The pump used for air injection was a ½-HP diaphragm pump. Air and helium were injected through monitoring points N1-MPA-6.5', N1-MPA-9.0', N1-MPB-6.5', and N1-MPB-9.0' at the depths indicated by the labels. After the air/helium injection was turned off, the respiration gases were monitored periodically. The respiration test was terminated on August 17.

Helium concentrations were measured during the in situ respiration test to quantify helium leakage to or from the surface around the monitoring points. Helium loss over time is attributed to either diffusion or leakage. A rapid drop in helium concentration followed by a leveling is an indication of leakage. A gradual loss along with an apparent first-order curve is an indicator of diffusion. As a rough estimate, the diffusion of gas molecules is inversely proportional to the square root of the molecular weight of the gas. Based on molecular weights of 4 for helium and 32 for oxygen, helium diffuses about 2.8 times faster than oxygen, or the diffusion of oxygen is 0.35 times the rate of helium diffusion. As a general rule, we have found that if helium concentrations are at least 50 to 60% of the initial levels at test completion, measured oxygen uptake rates are representative. Greater helium loss indicates a problem, and oxygen utilization rates are not considered representative.

To compare data from one site to another, a stoichiometric relationship of the oxidation of the hydrocarbon was assumed. Hexane was used as the representative hydrocarbon for the organic contaminant. The stoichiometric relationship is given by:



Based on the utilization rates (% per day), the biodegradation rates in terms of milligrams as a hexane equivalent per kilogram of soil per day were computed using the equation below by assuming a soil porosity of 0.2 and a bulk density of 1,440 kg/m<sup>3</sup>.

$$K_{\beta} = \frac{-K_o A D_o C}{100} \quad (2)$$

where:

$K_{\beta}$	=	biodegradation rate (mg/kg/day)
$K_o$	=	oxygen utilization rate (percent per day)
A	=	volume of air/kilogram of soil, in this case $300/1,440 = 0.21$
$D_o$	=	density of oxygen gas (mg/L) assumed to be 1,330 mg/L
C	=	mass ratio of hydrocarbon to oxygen required for mineralization, assumed to be 1:3.5 from the above stoichiometric equation.

## 2.2 Results and Discussion

### 2.2.1 Soil and Soil Gas Analyses

Results of the soil analyses for BTEX and TPH at Facility 27 are presented in Table 2. No detectable concentrations of the BTEX compounds were found in the soil samples, and relatively low TPH concentrations were found with concentrations averaging only 43 mg/kg. Soil gas analyses also showed relatively low BTEX and TPH concentrations, with concentrations ranging from below the detection limit up to 0.046 ppmv of benzene and from 130 to 2,200 ppmv of TPH (Table 2). The results from the soil chemistry analyses are summarized in Table 3. The laboratory report for the BTEX, TPH, and soil chemistry analyses is given in Appendix B.

### 2.2.2 Soil Gas Permeability and Radius of Influence

The raw data for the soil gas permeability test at Facility 27 are presented in Appendix C. Using the Hyperventilate™ computer model, soil gas permeabilities were calculated at each of the monitoring points. These data are presented in Table 4. The measurable soil gas permeability varied considerably between points with values ranging from 0.026 to  $4.3 \times 10^{10}$  darcys. No pressure could be detected at any of the soil gas probes at monitoring point C. The radius of influence where 1 inch

Table 2. Results From Soil and Soil Gas Analyses for BTEX and TPH at Facility 27

Matrix	Sample Name	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Total Xylenes (mg/kg)	TPH <sup>1</sup> (mg/kg)
Soil	N1-A-4'-4.5'	<0.0010	<0.0020	<0.0020	<0.0020	49
	N1-A-8'-9'	<0.0010	<0.0020	<0.0020	<0.0020	36
Matrix	Sample Name	Benzene (ppmv)	Toluene (ppmv)	Ethylbenzene (ppmv)	Total Xylenes (ppmv)	TPH <sup>2</sup> (ppmv)
Soil Gas	N1-A-6.5	0.046	0.0080	<0.0020	0.0030	2,200
	N1-C-8'	0.0050	0.0060	<0.0040	<0.0040	130
	N1-V-11.2	<0.011	0.056	0.026	0.31	800

<sup>1</sup> Referenced to a reference oil composed of a mixture of 2,2,4-trimethylpentane, *n*-hexadecane, and chlorobenzene.

<sup>2</sup> TPH referenced to jet fuel (molecular weight = 156).



Table 3. Results From Soil Chemistry Analyses at Facility 27

Parameter	Sample Name	
	N1-A-4'-4.5'	N1-A-8'-9'
Alkalinity (mg/kg CaCO <sub>3</sub> )	410	330
Moisture (% by weight)	18.2	14.0
pH	7.7	7.8
Iron (mg/kg)	16,400	14,400
Total Phosphorous (mg/kg)	570	460
Total Kjeldahl Nitrogen (mg/kg)	300	400
Particle Size Analysis (%)	Gravel: 6.2	Gravel: 26
	Sand: 33.8	Sand: 42
	Silt: 38	Silt: 23
	Clay: 22	Clay: 9

Table 4. Results of Hyperventilate™ Soil Gas Permeability Analysis at Facility 27

Monitoring Point	Depth (ft)	Soil Gas Permeability (darcy)
N1-MPA	4.0	0.026
	6.5	970
	9.0	$4.3 \times 10^{10}$
N1-MPB	4.0	$9.3 \times 10^5$
	6.5	$4.4 \times 10^5$
	9.0	$1.3 \times 10^7$
N1-MPC	2.7	NM
	5.0	NM
	8.0	NM

NM No pressure change could be measured at this point.

of pressure was measured was calculated by plotting the log of the pressure change at the monitoring points versus the distance from the vent well (Figure 6). Based on these specifications, the radius of influence at Facility 27 is estimated to be approximately 12 feet.

### 2.2.3 In Situ Respiration Test

The results of the in situ respiration test for Facility 27 are presented in Appendix D. Each figure in Appendix D illustrates the oxygen, carbon dioxide, and helium concentrations as a function of time. An example of typical oxygen utilization and carbon dioxide production at this site is shown in Figure 7, which shows oxygen, carbon dioxide, and helium at monitoring point N1-MPB-9'. The rates of oxygen utilization and carbon dioxide production and the corresponding biodegradation rates are summarized in Table 5. The biodegradation rates measured at this site were fairly consistent between the monitoring points, with rates ranging from 2.1 to 7.5 mg/kg/day based upon oxygen and from 0.58 to 1.4 mg/kg/day for carbon dioxide.

Loss of helium was insignificant at all monitoring points, indicating that the monitoring points were well-sealed and that the oxygen depletion observed was a result of biodegradation.

Soil temperatures were measured during the in situ respiration test. Temperatures during the test ranged from 23.9 to 27°C at monitoring point N1-MPA-4.0' and from 18.9 to 20°C at monitoring point N1-MPA-9.0'.

### 2.2.4 Bioventing Demonstration

The decision was made to install a bioventing system at Facility 27. The same blower that was used for the soil gas permeability test was installed for the bioventing system. The system was configured for air extraction due to its proximity to the service station offices. A sample of the exhaust gas was collected after 1 hour of operation. No detectable concentrations of BTEX were found, and the maximum TPH concentration was 130 ppm. The analytical report for these samples is given in Appendix B (Samples N1-EX-1210 and N1-EX-1220). Approval was given to operate the system, and continuous air extraction was initiated during the second week of November 1992. Due to construction in the area, the system was shut down on January 8, 1993 and was restarted on February 4, 1993.

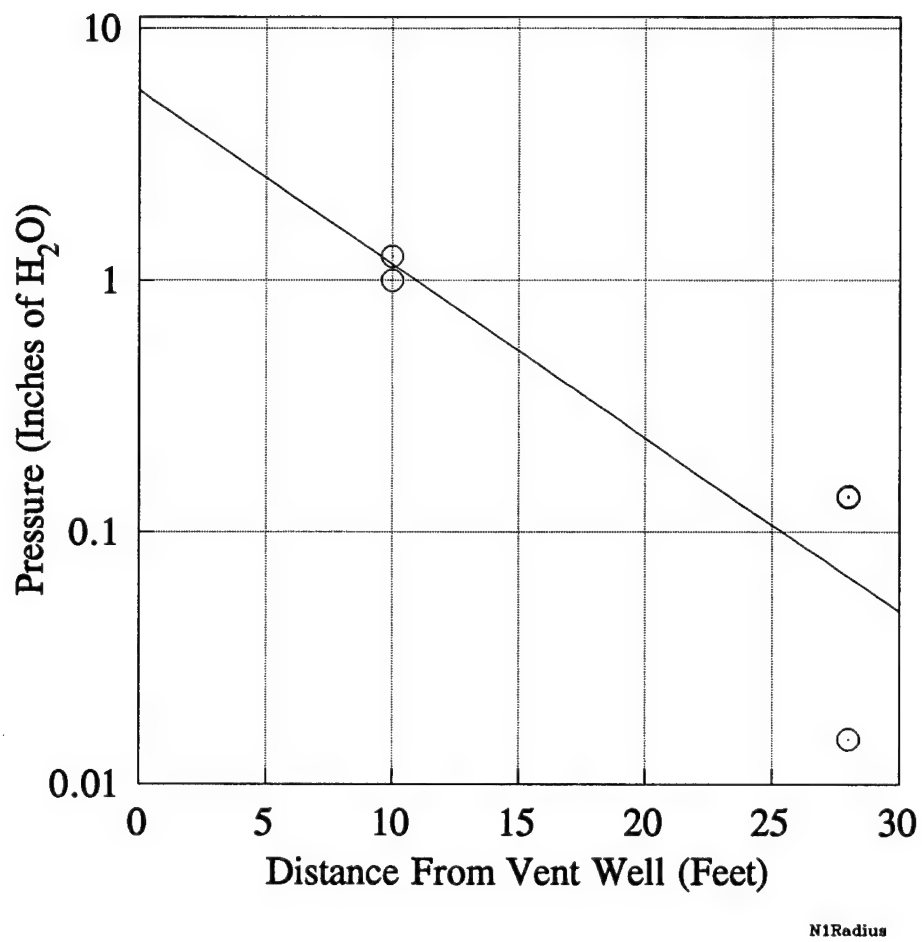


Figure 6. Radius of Influence at Facility 27

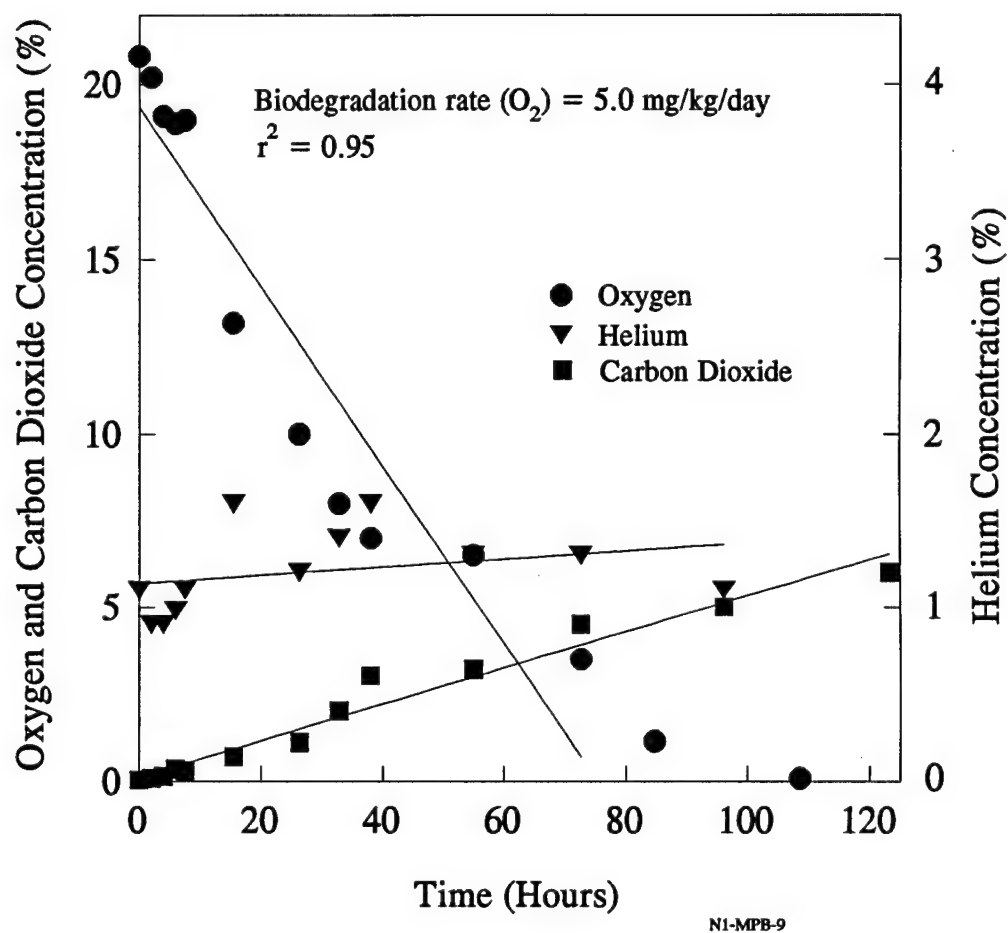


Figure 7. Oxygen Utilization and Carbon Dioxide Production During the In Situ Respiration Test at Monitoring Point N1-MPB-9.0'

**Table 5. Oxygen Utilization and Carbon Dioxide Production Rates During the In Situ Respiration Test at Facility 27**

<b>Sample Name</b>	<b>Oxygen Utilization Rate (%/hour)</b>	<b>Biodegradation Rate (mg/kg/day)</b>	<b>Carbon Dioxide Production Rate (%/hour)</b>	<b>Biodegradation Rate (mg/kg/day)</b>
Background	0.040	0.80	0.017	0.37
N1-MPA-6.5'	0.39	7.5	0.064	1.4
N1-MPA-9.0'	0.11	2.1	0.027	0.58
N1-MPB-6.5'	0.27	5.2	0.064	1.4
N1-MPB-9.0'	0.26	5.0	0.063	1.4

### **3.0 FACILITY 89**

#### **3.1 Chronology of Events and Site Activities**

##### **3.1.1 Groundwater Measurements**

Groundwater measurements were taken from the vent well installed at the Facility 89 site. The groundwater level was recorded at 6.8 feet.

##### **3.1.2 Soil Gas Survey**

A limited soil gas survey was conducted on July 28, 1992 to locate a suitable test area at Facility 89. Soil gases were sampled by driving a 5/8-inch-diameter stainless steel probe into the soil with a hammer drill. Soil gas was withdrawn with a vacuum pump and analyzed for oxygen, carbon dioxide, and TPH. Measurements of oxygen, carbon dioxide, and TPH in the soil gas were made as described in Section 2.0.

The soil gas probes were driven to depths ranging from 2.5 to 7.5 feet at several locations at Facility 89. Table 6 provides the initial concentrations of oxygen, carbon dioxide, and TPH for the various locations at Facility 89. Oxygen concentrations varied from 5.8 to 21%, whereas TPH concentrations ranged from 0 to 1,000 ppm. These results indicate that, although not all areas of the site are oxygen-limited, some areas may respond to bioventing.

##### **3.1.3 Vent Well, Monitoring Point, and Thermocouple Installation**

On July 30, 1992, the vent well (VW) and three monitoring points (MPs) were installed at Facility 89, and collection of soil samples for analyses was begun. The monitoring points were labeled N2-MPA, N2-MPB, and N2-MPC. The location of the vent well and monitoring points is shown in Figure 3. A cross section of the vent well and monitoring points showing site lithology and construction detail is shown in Figure 8.

The vent well was installed at a depth of 10.2 feet into an 8-inch-diameter borehole. The vent well consisted of Schedule 40 2-inch-diameter PVC piping with 7.6 feet of ten-slot screen. The annular space corresponding to the screened area of the well was filled with silica sand; the annular

Table 6. Initial Soil Gas Composition at Facility 89

Soil Gas Survey Point	Depth (ft)	Oxygen (%)	Carbon Dioxide (%)	TPH (ppm)
GS-1	2.5	19.8	0.060	100
	5.0	14.5	3.8	190
	5.7	18	2.5	340
GS-2	2.5	12.8	5.3	230
	5.0	18	2.3	420
GS-3	2.5	18	2.0	180
	5.0	17.9	2.5	180
	7.5	21 <sup>1</sup>	0.060	75
GS-4	2.5	12.5	3.3	580
	5.0	21 <sup>1</sup>	0.050	100
GS-5	2.5	21 <sup>1</sup>	0.050	170
	5.0	15	1.2	210
GS-7	2.5	16.5	2.2	1,000
	5.0	7.5	5.2	190
GS-8	2.5	16	3.3	120
GS-9	2.5	16	3.6	170
GS-10	2.5	16	4.0	280
GS-11	2.5	21 <sup>1</sup>	0.050	190
GS-12	2.5	17	3.5	150
	5.0	21 <sup>1</sup>	0.050	140
GS-13	2.5	11.5	5.8	120
	5.0	14	4.3	220
GS-14	2.5	5.8	5.2	140

<sup>1</sup> Pressure reading on sampling pump was high. Measured oxygen concentration may not be representative of actual soil gas oxygen concentrations. Actual oxygen concentration is likely to be lower.



**Figure 8. Cross Section of Vent Well and Monitoring Points at Facility 89 Showing Site Lithology and Construction Detail**



space above the screened interval was filled with bentonite to prevent short-circuiting of air to or from the surface.

Soil gas probes consisted of ¼-inch tubing with a 1-inch-diameter, 6-inch screened area. The annular space corresponding to the screened area was filled with silica sand. The interval between the screened areas was filled with bentonite, as was the annular space from the shallowest monitoring point to the ground surface. The monitoring points were installed as follows:

- Monitoring point N2-MPA was installed at a depth of 10.0' into an 8-inch-diameter borehole. The monitoring point was screened to three depths: 2.0', 4.5', and 7.0'.
- Monitoring point N2-MPB was installed at a depth of 12.0' into an 8-inch-diameter borehole. The monitoring point was screened to three depths: 5.0', 7.5', and 10.0'.
- Monitoring point N2-MPC was installed at a depth of 10.3' into an 8-inch-diameter borehole. The monitoring point was screened to three depths: 4.7', 6.5', and 9.0'.

A Type J thermocouple was installed with monitoring points N2-MPA-2.0' and N2-MPA-7.0'.

### 3.1.4 Soil and Soil Gas Sampling and Analyses

Soil samples were collected from depths of 4.3 to 4.8 feet and from 9.0 to 9.5 feet from the vent well borehole and were labeled N2-V-4.3'-4.8' and N2-V-9.0'-9.5', respectively. A soil sample also was taken from monitoring point N2-MPC at a depth of 10.0 feet and was labeled N2-C-10'. The samples were sent under chain of custody to Engineering-Science, Inc., Berkeley Laboratory for analyses of BTEX, TPH, alkalinity, moisture content, pH, iron, total phosphorous, total Kjeldahl nitrogen, and particle size analysis. Soil gas samples were collected from monitoring points N2-MPC-6.5' and N2-MPC-9.0' and from the vent well. These samples were labeled N2-C-6.5, N2-C-9, N2-V-3-9. These samples were sent under chain of custody to Air Toxics, Ltd., in Rancho Cordova, California, for analyses of BTEX and TPH.

### 3.1.5 Soil Gas Permeability and Radius of Influence

A detailed description of the method for conducting a soil gas permeability test, including equations to compute  $k$ , the soil gas permeability, is described in the Test Plan and Technical Protocol (Hinchee et al., 1992).

The monitoring points at Facility 89 were allowed to set up for 24 hours prior to air injection. A portable 2.5-HP explosion-proof positive displacement blower unit was used to inject air. After air injection was initiated, pressure readings were taken approximately every 1 to 2 minutes for the first hour, then approximately every 10 minutes for the following hour. The Hyperventilate™ computer model was used to calculate the soil gas permeability.

### 3.1.6 In Situ Respiration Test

Immediately following the soil gas permeability test at Facility 89, air containing approximately 1% helium was injected into the soil for approximately 24 hours beginning on August 6, 1992. Air was injected concurrently into the background monitoring well to measure the natural biodegradation of organic material in the soil. The setup for the in situ respiration test was as described in the Test Plan and Technical Protocol (Hinchee et al., 1992). The pump used for air injection was a ½-HP diaphragm pump. Air and helium were injected through monitoring points N2-MPA-7.0', N2-MPB-7.5', N2-MPB-10.0', and N2-MPC-6.5' at the depths indicated by the labels. After the air/helium injection was turned off, the respiration gases were monitored periodically. The respiration test was terminated on August 10. Results of the in situ respiration were calculated as described in Section 2.1.6.

## 3.2 Results and Discussion

### 3.2.1 Soil and Soil Gas Analyses

Results of the soil analyses for BTEX and TPH at Facility 89 are presented in Table 7. No detectable concentrations of BTEX were measured in any soil samples, and TPH was only detected at a concentration of 31 mg/kg from the vent well soil sample. The soil gas analyses also showed low BTEX and TPH concentrations, with concentrations ranging from below the detection limit to 0.027

Table 7. Results From Soil and Soil Gas Analyses for BTEX and TPH at Facility 89

Matrix	Sample Name	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Total Xylenes (mg/kg)	TPH <sup>1</sup> (mg/kg)
Soil	N2-V-4.3'-4.8'	<0.0010	<0.0020	<0.0020	<0.0020	31
	N2-V-9.0'-9.5'	<0.0010	<0.0020	<0.0020	<0.0020	<5.0
	N2-C-10'	<0.0010	<0.0020	<0.0020	<0.0020	<5.0
Matrix	Sample Name	Benzene (ppmv)	Toluene (ppmv)	Ethylbenzene (ppmv)	Total Xylenes (ppmv)	TPH <sup>2</sup> (ppmv)
Soil Gas	N2-V-3-10	<0.021	<0.021	<0.021	<0.021	74
	N2-C-6.5	0.0080	0.027	0.0020	0.012	7.8
	N2-C-9	0.0030	0.0060	<0.0020	0.0040	3.5

<sup>1</sup> Referenced to a reference oil composed of a mixture of 2,2,4-trimethylpentane, *n*-hexadecane, and chlorobenzene.

<sup>2</sup> TPH referenced to jet fuel (molecular weight = 156).

ppmv of toluene and from 3.5 to 74 ppmv of TPH (Table 7). The results from the soil chemistry analyses are summarized in Table 8. The laboratory report for the BTEX, TPH, and soil chemistry analyses is given in Appendix B.

### 3.2.2 Soil Gas Permeability and Radius of Influence

The raw data for the soil gas permeability test at Facility 89 are presented in Appendix E. Using the Hyperventilate™ computer model, soil gas permeabilities were calculated at each of the monitoring points. These data appear in Table 9. The measurable soil gas permeability varied considerably between points with values ranging from 6.6 up to  $8.7 \times 10^9$  darcy. No pressure change could be detected at any of the soil gas probes at monitoring point C. Typically, the radius of influence is calculated by plotting the log of the pressure change at a specific monitoring point versus the distance from the vent well. The radius of influence would then be the distance where 1 inch of

water pressure can be measured. However, in this instance, 1 inch of water pressure was not achieved at any monitoring point; therefore, a radius of influence based on these specifications cannot be definitively determined at this site, other than to say it is less than 19.7 feet, the distance from the vent well to the closest monitoring point.

### **3.2.3 In Situ Respiration Test**

The results of the in situ respiration test for Facility 89 are presented in Appendix F. Each figure in Appendix F illustrates the oxygen, carbon dioxide, and helium concentrations as a function of time. An example of typical oxygen utilization and carbon dioxide production at this site is shown in Figure 9, which shows oxygen, carbon dioxide, and helium at monitoring point N2-MPA-7'. Biodegradation rates were relatively low at all monitoring points. The rates of oxygen utilization and carbon dioxide production and the corresponding biodegradation rates are summarized in Table 10. The biodegradation rates measured at this site were relatively low, with rates ranging from 0.27 to 0.52 mg/kg/day based on oxygen and from 0.013 to 0.28 mg/kg/day based on carbon dioxide.

Loss of helium was insignificant at all monitoring points, indicating that the monitoring points were well sealed and that the oxygen depletion observed was a result of biodegradation.

Soil temperatures were measured at monitoring point N2-MPA-2.0' during the in situ respiration test. Temperatures during the test ranged from 20.8 to 21.5°C.

### **3.2.4 Bioventing Demonstration**

The decision was made to install a bioventing system at Facility 89. The same blower that was used for the soil gas permeability test was installed for the bioventing system. Continuous air injection was initiated on September 9, 1992 at a flowrate of 27 scfm.

Table 8. Results From Soil Chemistry Analyses at Facility 89

Parameter	Sample Name	
	N2-V-3'-4'	N2-V-8'-9'
Alkalinity (mg/kg CaCO <sub>3</sub> )	420	490
Moisture (% by weight) <sup>1</sup>	15.0	16.8
pH	7.8	7.7
Iron (mg/kg)	18,000	14,200
Total Phosphorus (mg/kg)	540	540
Total Kjeldahl Nitrogen (mg/kg)	450	270
Particle Size Analysis (%)	Gravel: 10	Gravel: 1.3
	Sand: 42	Sand: 38.7
	Silt: 33	Silt: 45
	Clay: 15	Clay: 15

<sup>1</sup> Three soil samples were analyzed for moisture content only. These results were N2-V-4.3'-4.8', 15.7%; N2-V-9.0'-9.5', 26.1%; and N2-C-10', 20.7%.

**Table 9. Results of Hyperventilate™ Soil Gas Permeability Analysis at Facility 89**

Monitoring Point	Depth (ft)	Soil Gas Permeability (darcy)
N2-MPA	2.0	6.6
	4.5	$8.7 \times 10^9$
	7.0	ND
N2-MPB	5.0	370
	7.5	$2.8 \times 10^5$
	10.0	22
N2-MPC	4.7	NM
	6.5	NM
	9.0	NM

ND No data were collected at this monitoring point.

NM No pressure change was measured at this monitoring point.

**Table 10. Oxygen Utilization and Carbon Dioxide Production Rates During the In Situ Respiration Test at Facility 89**

Sample Name	Oxygen Utilization Rate (%/hour)	Biodegradation Rate (mg/kg/day)	Carbon Dioxide Production Rate (%/hour)	Biodegradation Rate (mg/kg/day)
Background	0.042	0.80	0.017	0.37
N2-MPA-7.0'	0.015	0.29	0.012	0.26
N2-MPB-7.5'	0.027	0.52	0.0060	0.013
N2-MPB-10.0'	0.014	0.27	0.013	0.28
N2-MPC-6.5'	0.027	0.52	0.0030	0.065

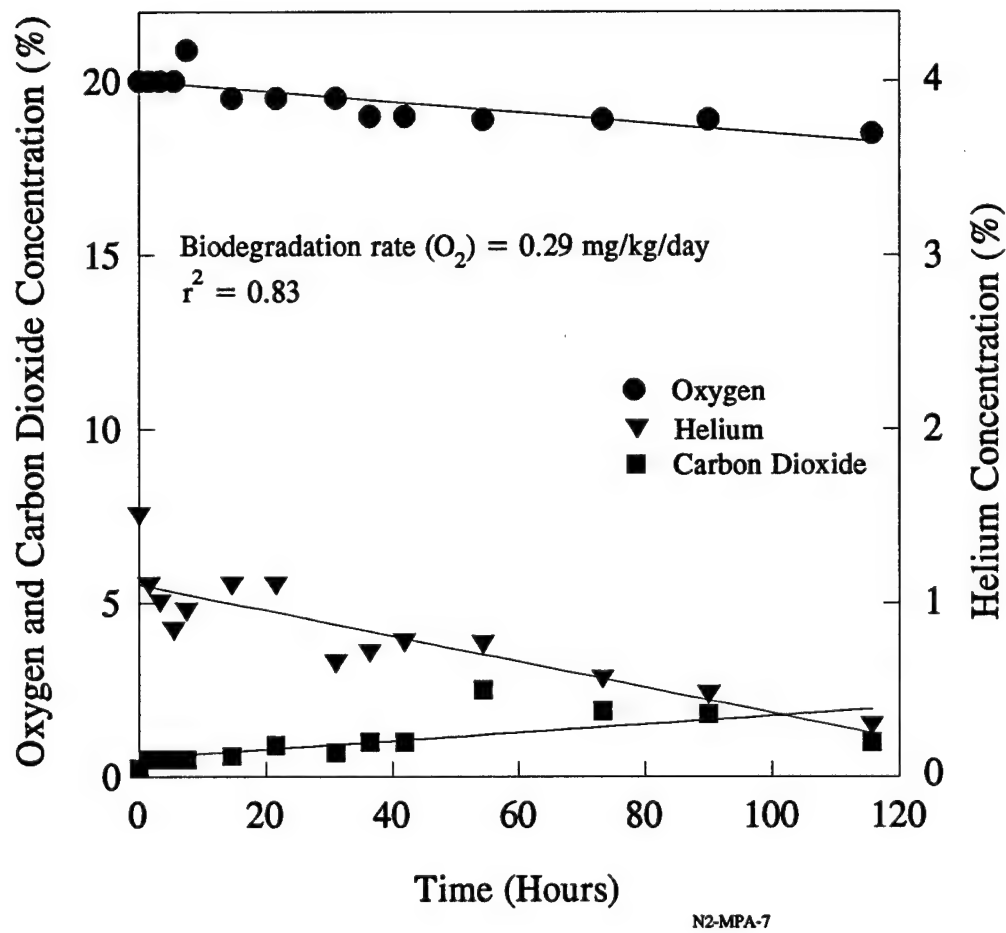


Figure 9. Oxygen Utilization and Carbon Dioxide Production During the In Situ Respiration Test at Monitoring Point N2-MPA-7.0'

## **4.0 FACILITY 14**

### **4.1 Chronology of Events and Site Activities**

An air permeability test and an in situ respiration test were not conducted at this site. Originally, these tests were to be conducted at a later date if funding were available. However, the site has been declared clean by the State of Ohio and no further work is planned for this site. Only initial site activities and soil sampling results are presented in this section.

#### **4.1.1 Groundwater Measurements**

One groundwater monitoring well was measured at Facility 14. The groundwater level was recorded at 4.0 feet.

#### **4.1.2 Soil Gas Survey**

A limited soil gas survey was conducted on July 29, 1992 to locate a suitable test area at Facility 14. Soil gases were sampled by driving a 5/8-inch-diameter stainless steel probe into the soil with a hammer drill. Soil gas was withdrawn with a vacuum pump and analyzed for oxygen, carbon dioxide, and TPH. Measurements of oxygen, carbon dioxide, and TPH in the soil gas were made as described in Section 2.0.

The soil gas probes were driven to depths ranging from 2.0 to 4.5 feet at several locations at Facility 14. Table 11 provides the initial concentrations of oxygen, carbon dioxide, and TPH for the various locations at Facility 14. Oxygen concentrations varied from 0 to 21%, whereas TPH concentrations ranged from 0 to 700 ppm. These results suggest that there is little hydrocarbon contamination at the site, although some areas appear to be oxygen-limited.

#### **4.1.3 Vent Well, Monitoring Point, and Thermocouple Installation**

On August 17, 1992, a vent well (VW) and three monitoring points (MPs) were installed at Facility 14, and collection of soil samples for analyses was begun. The monitoring points were labeled N3-MPA, N3-MPB, and N3-MPC. The location of the vent well and monitoring points is



Table 11. Initial Soil Gas Composition at Facility 14

Soil Gas Survey Point	Depth (ft)	Oxygen (%)	Carbon Dioxide (%)	TPH (ppm)
GS-1	2.0	20	0.02	54
	3.5	19.8	0.5	66
GS-2	2.5	0.38	5.0	350
GS-3	2.0	11.0	4.0	240
	3.5	11.0	3.8	380
GS-4	2.5	17 <sup>1</sup>	1.0	100
GS-5	2.5	17.8	1.2	170
GS-7	2.5	18.9	0.9	170
GS-8	2.5	8.5	6.5	700
	4.0	15.5	2.3	400
GS-9	2.5	20	0.05	400
	4.0	21	0.05	210
GS-10	2.5	1.5	7.2	85
	4.0	11.5 <sup>1</sup>	3.7	82
GS-11	2.5	2.1	6.9	172
	3.5	2.0	6.9	182
GS-12	2.5	0	11.5	120
	4.0	0	11.5	240
GS-13	2.5	4.5	10	202
	4.0	4.5	10	220
GS-14	2.5	21	0.7	0
	4.5	17	1.2	80
GS-15	2.5	15.5	3.7	150

<sup>1</sup> Pressure reading on sampling pump was high. Measured oxygen concentration may not be representative of actual soil gas oxygen concentrations. Actual oxygen concentration is likely to be lower.

shown in Figure 4. A cross section of the vent well and monitoring points showing site lithology and construction detail is shown in Figure 10.

The vent well was installed at a depth of 7.25 feet into an 8-inch-diameter borehole. The vent well consisted of Schedule 40 2-inch-diameter PVC piping with 5.0 feet of ten-slot screen. The annular space corresponding to the screened area of the well was filled with silica sand; the annular space above the screened interval was filled with bentonite to prevent short-circuiting of air to or from the surface.

Soil gas probes consisted of 1/4-inch tubing with a 1-inch-diameter, 6-inch screened area. The annular space corresponding to the screened area was filled with silica sand. The interval between the screened areas was filled with bentonite, as was the annular space from the shallowest monitoring point to the ground surface. The monitoring points were installed as follows:

- Monitoring point N3-MPA was installed at a depth of 7.3' into an 8-inch-diameter borehole. The monitoring point was screened to three depths: 2.2', 3.7', and 7.0'.
- Monitoring point N3-MPB was installed at a depth of 7.5' into an 8-inch-diameter borehole. The monitoring point was screened to three depths: 2.0', 4.0', and 7.0'.
- Monitoring point N3-MPC was installed at a depth of 9.0' into an 8-inch-diameter borehole. The monitoring point was screened to three depths: 2.0', 4.0', and 7.0'.

A Type J thermocouple was installed with monitoring points N3-MPA-2.2' and N3-MPA-7.0'.

#### 4.1.4 Soil Sampling and Analyses

A soil boring sample was collected at a depth of 7.0 to 7.5 feet from the Facility 14 vent well borehole and was labeled N3-V-7'-7.5'. Soil samples were also taken from monitoring points N3-MPA and N3-MPC and were labeled N3-A-2'-3', N3-A-6'-7', and N3-C-7.5'-8'. The samples were sent under chain of custody to Engineering-Science, Inc., Berkeley Laboratory for analyses of BTEX, TPH, alkalinity, moisture content, pH, iron, total phosphorous, total Kjeldahl nitrogen, and particle size analysis.

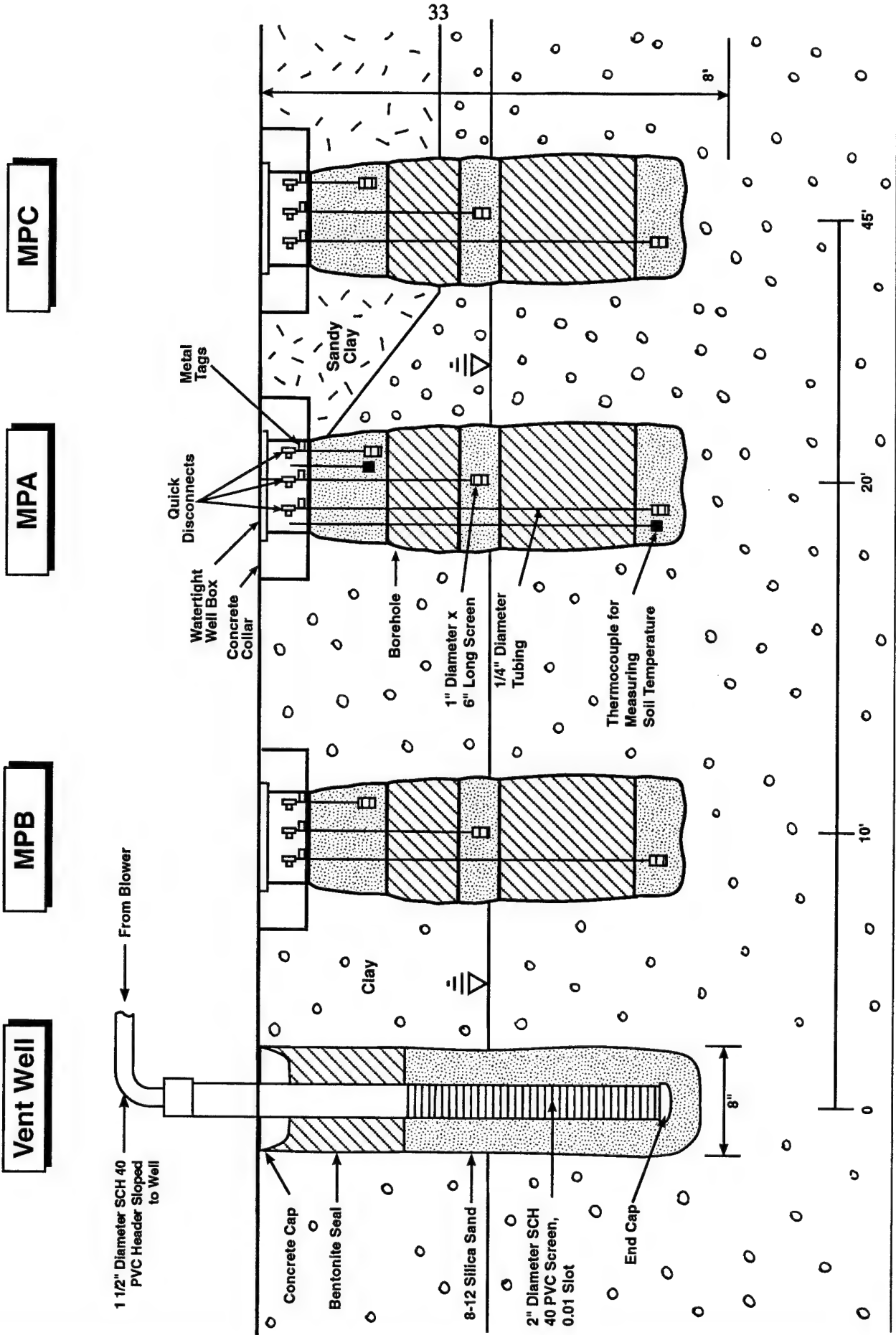


Figure 10. Cross Section of Vent Well and Monitoring Points at Facility 14 Showing Site Lithology and Construction Detail

## 4.2 Soil Analyses Results and Discussion

Results of the soil analyses for BTEX and TPH at Facility 14 are presented in Table 12. Concentrations in soil samples were relatively low, with no detectable concentrations of benzene up to 7.1 mg/kg toluene. TPH concentrations ranged from 54 to 350 mg/kg. The results from the soil chemistry analyses are summarized in Table 13. The laboratory report for the BTEX, TPH, and soil chemistry analyses is given in Appendix B.

**Table 12. Results From Soil Analyses for BTEX and TPH at Facility 14**

Sample Name	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Total Xylenes (mg/kg)	TPH <sup>1</sup> (mg/kg)
N3-V-7'-7.5'	<0.0035	7.1	0.049	0.22	350
N3-A-2'-3'	<0.00070	<0.00080	0.0080	0.046	54
N3-A-6'-7'	<0.00070	<0.00080	<0.00060	0.0019	68
N3-C-7.5'-8'	<0.00080	<0.00090	<0.00060	<0.0011	83

<sup>1</sup> Referenced to a reference oil composed of a mixture of 2,2,4-trimethylpentane, *n*-hexadecane, and chlorobenzene.

**Table 13. Results From Soil Chemistry Analyses at Facility 14**

Parameter	Sample Name		
	N3-V-6'-7'	N3-A-2'-3' <sup>1</sup>	N3-A-6'-7' <sup>1</sup>
Alkalinity (mg/kg CaCO <sub>3</sub> )	380	290	280
Moisture (% by weight) <sup>2</sup>	14.6	10.5	11.4
pH	8.1	7.8	7.8
Iron (mg/kg)	16,900	17,800	14,500
Total Phosphorous (mg/kg)	270	300	210
Total Kjeldahl Nitrogen (mg/kg)	240	240	110

<sup>1</sup> Soil moisture was calculated on a duplicate sample. Results were N3-A-2'-3', 14.8; and N3-A-6'-7', 15.2.

<sup>2</sup> Soil moisture was calculated on two other samples. Results were N3-V-7'-7.5', 14.1; and N3-C-7.5'-8', 19.9.

## 5.0 BACKGROUND AREA

A background vent well was installed on July 29, 1992 near Facility 27 (Figure 1). The depth of the vent well was 11.2 feet with 6.7 feet of screen using schedule 40, 2-inch-diameter, 10-slot PVC, and 4.5 feet of schedule 40, 2-inch-diameter PVC riser. The area corresponding to the screened section was surrounded by sand, and the remaining 4.5 feet were enclosed by bentonite to seal the vent well.

Soil and soil gas samples were collected from the background area. The site lithology in this area was similar to that in the contaminated areas. Results of analyses for BTEX and TPH are shown in Table 14. No detectable concentrations of BTEX were found in the soil samples, and only minimal concentrations were found in the soil gas samples. TPH concentrations also were low in both soil and soil gas samples. The results from the soil chemistry analyses are shown in Table 15. The analytical report for these samples is provided in Appendix B.

An in situ respiration test was conducted at the background area beginning on August 12 after 24 hours of air injection. The test was concluded on August 17. Biodegradation rates were relatively high in this area (Figure 11). These high rates could be due to the minimal amount of contamination present in this area, based on the soil samples.

Table 14. Results From Soil and Soil Gas Analyses for BTEX and TPH at Background Area

Matrix	Sample Name	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Total Xylenes (mg/kg)	TPH <sup>1</sup> (mg/kg)
Soil	N-BKG-4.5'-5.0'	<0.0010	<0.0020	<0.0020	<0.0020	20
	N-BKG-8.5'-9'	<0.0010	<0.0020	<0.0020	<0.0020	NA
	N-BKG-10	<0.0010	<0.0020	<0.0020	<0.0020	<4.0
Matrix	Sample Name	Benzene (ppmv)	Toluene (ppmv)	Ethylbenzene (ppmv)	Total Xylenes (ppmv)	TPH <sup>2</sup> (ppmv)
Soil Gas	N-BG	<0.0020	0.0020	<0.0020	0.0020	13

<sup>1</sup> Referenced to a reference oil composed of a mixture of 2,2,4-trimethylpentane, *n*-hexadecane, and chlorobenzene.

<sup>2</sup> TPH referenced to jet fuel (molecular weight = 156).

NA Sample not analyzed for this parameter.

Table 15. Results From Soil Chemistry Analyses at the Background Area

Parameter	Sample Name	
	N-BKG-4.5'-5.0'	N-BKG-8.5'-9'
Alkalinity (mg/kg CaCO <sub>3</sub> )	36	120
Moisture (% by weight)	12.9	14.7
pH	6.4	7.4
Iron (mg/kg)	13,000	15,700
Total Phosphorous (mg/kg)	480	470
Total Kjeldahl Nitrogen (mg/kg)	730	300
Particle Size Analysis (%)	Gravel: 20	Gravel: 25
	Sand: 45	Sand: 37
	Silt: 26	Silt: 26
	Clay: 9	Clay: 12

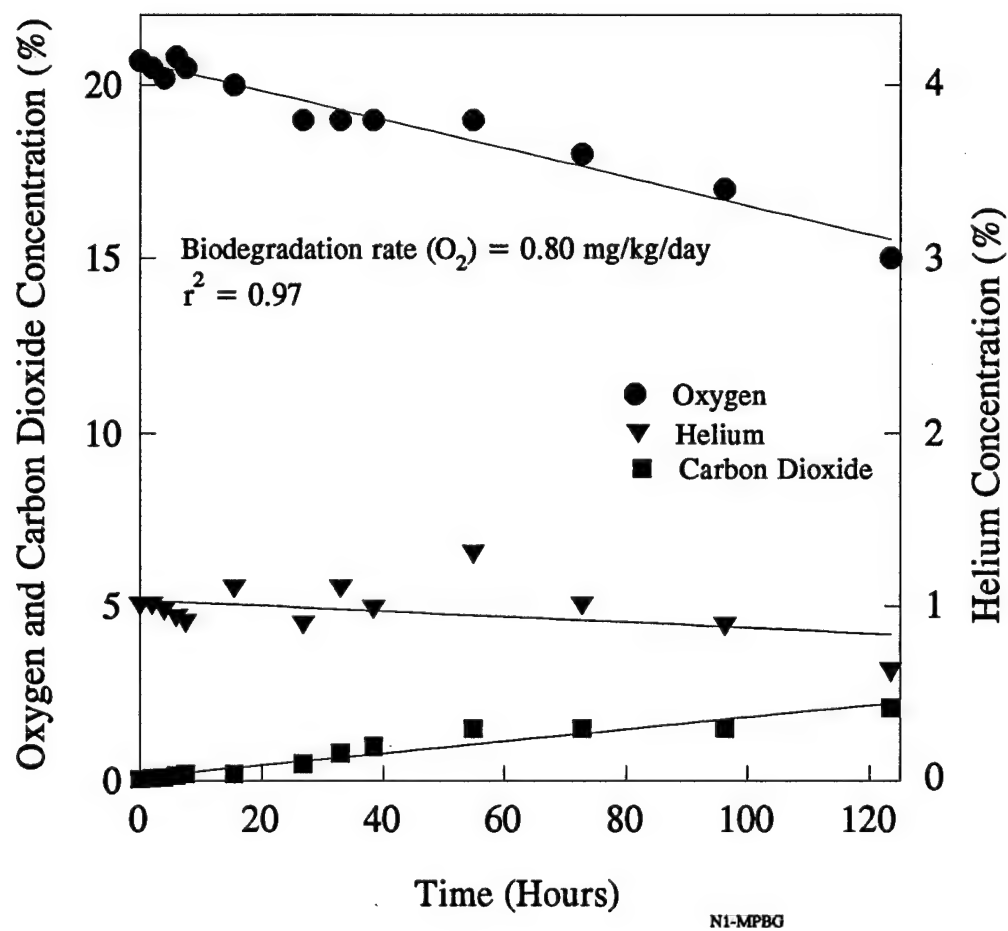


Figure 11. Oxygen Utilization and Carbon Dioxide Production During the In Situ Respiration Test at the Background Area

## 6.0 FUTURE WORK

Base personnel will be required to perform a simple weekly system check to ensure that the blower is operating within its intended flowrate, pressure, and temperature range. An on-site briefing was conducted for base personnel who will be responsible for blower system checks. The principle of operation was explained, and a simple checklist and logbook were provided for blower data. Base personnel will perform minor maintenance activities, such as replacing filters or gauges, or draining condensate from knockout chambers, but they will not be expected to perform complicated repairs or analyze gas samples. Replacement filters and gauges will be provided and shipped to the base and serious problems, such as motor or blower failures, will be corrected by Battelle.

The progress of this system will be monitored by conducting semiannual respiration tests in the vent well and in each monitoring point, and by regularly measuring the oxygen, carbon dioxide, and hydrocarbon concentrations in the extracted soil gas and comparing them to background levels. Soil gas monitoring will be performed on a quarterly basis. At least twice each year, the progress of the bioventing test will be reported to the base point-of-contact.

## 7.0 REFERENCE

Hinchee, R.E., S.K. Ong, R.N. Miller, D.C. Downey, and R. Frandt. 1992. *Test Plan and Technical Protocol for a Field Treatability Test for Bioventing* (Rev. 2), Report prepared by Battelle Columbus Operations, U.S. Air Force Center for Environmental Excellence, and Engineering-Science, Inc. for the U.S. Air Force Center for Environmental Excellence, Brooks Air Force Base, Texas.



**APPENDIX A**  
**TEST PLAN FOR NEWARK AFB**



505 King Avenue  
Columbus, Ohio 43201-2693  
Telephone (614) 424-6424  
Facsimile (614) 424-5263

July 13, 1992

Captain Cathy Vogel  
HQ AFCESA/RAVW  
139 Barnes Drive  
Tyndall Air Force Base,  
Florida 32403-5319

Dear Cathy:

**SUBJECT: TEST PLAN FOR BIOVENTING INITIATIVE  
FIELD TEST AT FACILITIES 27 AND 89, NEWARK AFB, OH**

Attached is the report "Test Plan and Technical Protocol for a Field Treatability Test for Bioventing." This document was developed as a generic test plan for the Air Force Bioventing Initiative Project in which Newark AFB is participating. This letter outlines site specific information to support the generic test plan.

The sites chosen for the bioventing test initiative are Facility 27 (the base motor pool), with three fiberglass UST's (1000 gal. unleaded gasoline, 4000 gal. unleaded gasoline, and 4000 gallon diesel), and Facility 89 which is the site of a 20,000 gallon diesel tank. Both sites are active fuel dispensing facilities. At both facilities, site characterization data has indicated soil contaminated with petroleum hydrocarbons in the tank cavity and supply line backfill.

The purpose of this project is to investigate the feasibility of using the bioventing technology to remediate petroleum contaminated soils at the Facility 27 and 89 sites.

Figure 1 is a site diagram for Facility 27 showing soil sampling locations for two sampling events (October, 1991 and February, 1992). Table 1 presents the analytical data for each sampling event. The high permeability of the UST backfill relative to the native soils could cause short circuiting of air flow during the air permeability test. During the soil gas survey Battelle will try to identify an area adjacent to the UST system that is sufficiently contaminated for conduct of the test. Soil sample locations 1, 2, and 3 taken on February 6, 1992, appear to be the most promising locations for bioventing system installation.

TABLE 1. SOIL CONTAMINANT CONCENTRATIONS AT FACILITY 27, NEWARK AFB, OH.

CONCENTRATION  
(mg/Kg)

SAMPLE LOCATION	DEPTH(ft)	TPH	BENZENE	TOLUENE	ETHYLBENZENE	XYLENE
27-200	0.5	166	BDL	BDL	BDL	.009
27-201	0.5	133	BDL	BDL	BDL	BDL
27-202	0.5	110	BDL	BDL	BDL	BDL
27-203	0.5	130	BDL	BDL	BDL	.012
27-204	0.5	5,140	.024	<.230	<.230	.76
27-205	0.5	203	BDL	BDL	BDL	BDL
27-206	3	78	BDL	BDL	BDL	BDL
27-207	3	96	BDL	BDL	BDL	BDL
27-208	1.5	158	BDL	BDL	BDL	BDL
27-209	1.5	358	BDL	.007	.025	.011
27-210	1.5	94	BDL	BDL	BDL	BDL
27-211	1.5	59	BDL	BDL	BDL	BDL
27-212	1.5	57	BDL	BDL	BDL	BDL
27-213	water	0.766	BDL	BDL	BDL	BDL
27-1	1.5	1880	NA	NA	NA	NA
27-2	1.5	779	NA	NA	NA	NA
27-3	1.5	254	NA	NA	NA	NA
27-4	2.5	55	NA	NA	NA	NA
27-5	2.5	52	NA	NA	NA	NA
27-6	2.5	675	NA	NA	NA	NA
27-7	2.5	91	NA	NA	NA	NA

BDL - BELOW DETECTION LIMIT

NA - NOT APPLICABLE (samples analyzed for TPH only).

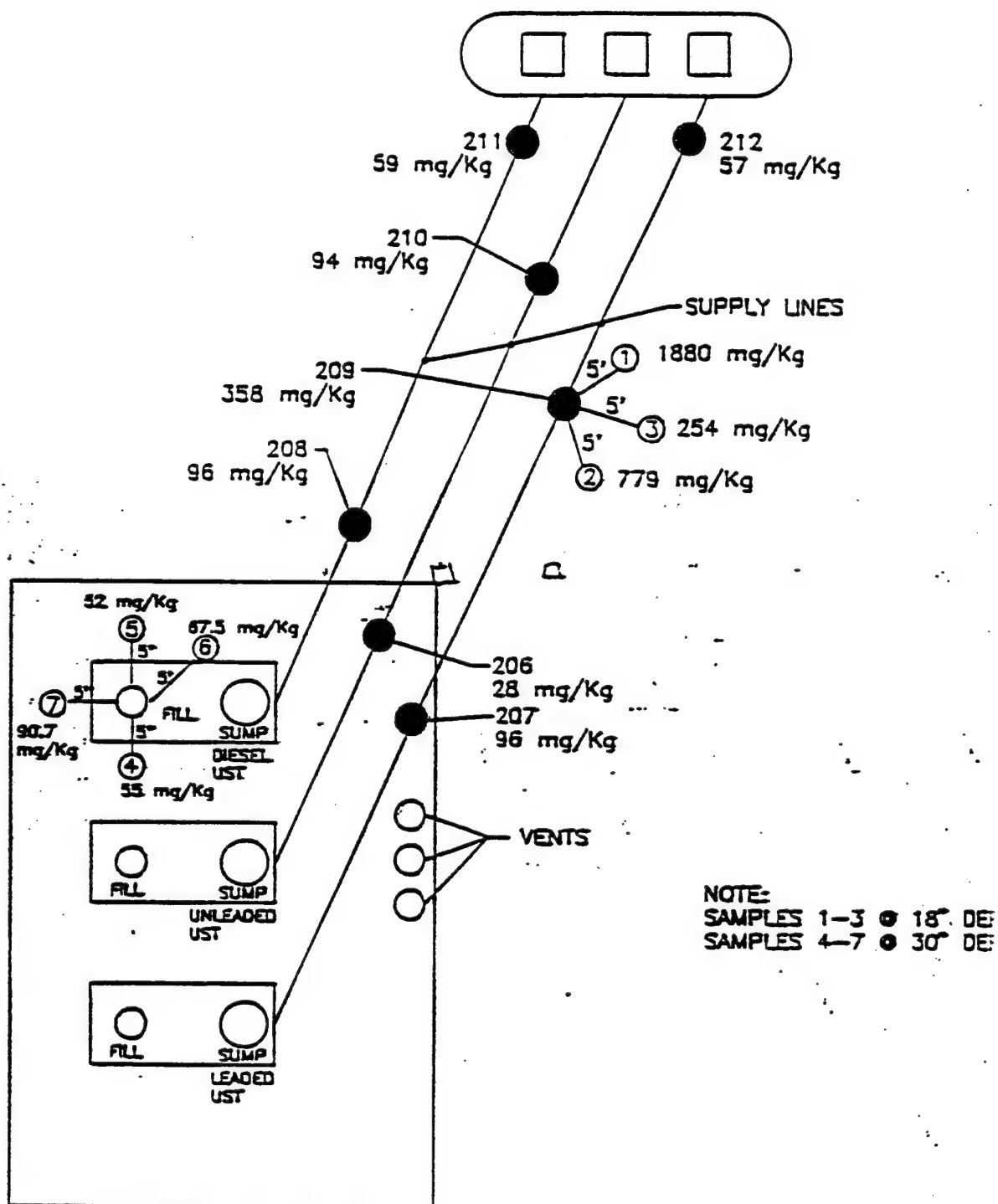


FIGURE 1 - Facility 27, NAFB, Newark, Ohio  
Second Phase Sampling, Feb. 6, 1992

Site diagram not to scale

● Sample locations 10/9 & 10/10, 1991

① Sample locations 2/6/1992

mg/Kg = TPH values

Figure 2 and Table 2 present the site diagram and the available soil analytical data for Facility 89, respectively. As with Facility 27, the soil sampling for Facility 89 was conducted in the UST backfill. As with Facility 27, an area adjacent to the fuel dispensing system will be identified for the test.

It is possible that at one of the facilities, or possibly even both facilities, it may not be possible to identify an area outside of the UST backfill that is suitable for the bioventing field testing. If this should be the case, Battelle will consult with the project officer and the base POC to determine whether the field tests should be conducted in the UST backfill. An in situ respiration test could be conducted and a bioventing blower could be installed, but due to the underground obstructions, installation of soil gas monitoring points in optimum locations may be inhibited and air permeability data may be inaccurate.

#### Project activities-

The following field activities are planned for the bioventing project at Newark AFB. the same procedures will be followed at each site. Additional detail can be found in Section 5.0 of the attached test plan and technical protocol.

- 1- A small scale soil gas survey will be conducted to identify an appropriate location for installation of the bioventing system. The soil gas survey will be conducted adjacent to the fuel dispensing systems outside of the UST backfill. Soil vapor from the candidate site should exhibit high petroleum hydrocarbon concentrations, relatively low O<sub>2</sub> concentrations (typically 0 % to 2.0 %), and relatively high CO<sub>2</sub> concentrations (depending on soil type, 2.0 % to 10.0 % or more). An uncontaminated background location will also be identified.
- 2- Once the installation sites are located one vent well and three 3-level soil gas monitoring points will be installed in the contaminated location and one vent well and one 3-level soil gas monitoring point will be installed in the background area. The wells and monitoring points will be installed using a two-man power auger to bore down to just above the water table. Three to four soil samples will be collected for chemical/physical analysis.
- 3- The air permeability test will be conducted in the contaminated test location.
- 4- Following the air permeability test, in situ respiration tests will be conducted in both the contaminated and the background test locations.
- 5- Depending on the results of the air permeability test and the in situ respiration test, a decision will be made whether or not to install a blower system in the contaminated area for the long term bioventing test. If the decision is made to install, the blower will be plumbed to the vent well and bioventing will be started

TABLE 2. CONTAMINANT CONCENTRATIONS AT FACILITY 89, NEWARK AFB, OH.

SAMPLE LOCATION	DEPTH(ft)	CONCENTRATION (mg/Kg)				
		TPH	BENZENE	TOLUENE	ETHYLBENZENE	XYLENE
89-1	0.5	7240	<.01	.094	.13	1.2
89-2	4	145	BDL	.006	.016	BDL
89-3	3.5	86	BDL	BDL	.007	BDL
89-4	3	283	BDL	BDL	.008	BDL
89-8	3	114	NA	NA	NA	NA
89-9	3	214	NA	NA	NA	NA
89-10	3	109	NA	NA	NA	NA
89-11	3	164	NA	NA	NA	NA
89-14	3	122	NA	NA	NA	NA
89-15	1.5	108	NA	NA	NA	NA
89-16	3	261	NA	NA	NA	NA
89-17	3	194	NA	NA	NA	NA
89-18	2	158	NA	NA	NA	NA
89-19	4	98	NA	NA	NA	NA

BDL - BELOW DETECTION LIMIT

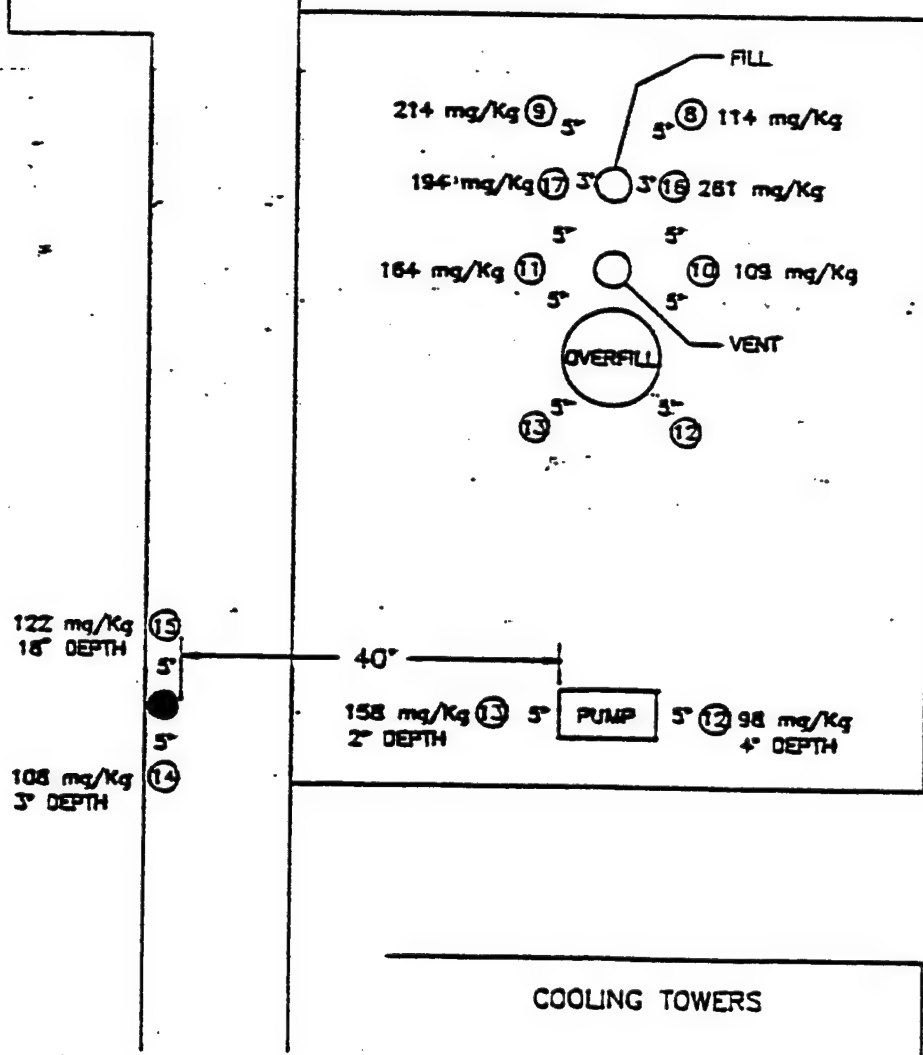
NA - NOT APPLICABLE (samples analyzed for TPH only)

BUILDING 6

6

NORTH

ROADWAY



NOTE:  
SAMPLES 8-13 @ 3"

FIGURE 2 - Facility 89, NAFB, Newark, Ohio  
Second Phase Sampling, Feb. 6, 1992

Site diagram not to scale

● Sample locations 10/9 & 10/10, 1991

⊕ Sample locations 2/6/1992

mg/Kg = TPH values

Captain Cathy Vogel  
Tyndall Air Force Base

7

July 13, 1992

(assuming power is available). Site personnel will be trained for blower operation prior to Battelle leaving the site.

- 6- A report detailing the results of the in situ respiration test and the air permeability test will be provided to the project officer and the base POC.

Schedule-

Field activities at Newark are planned to begin on July 27, 1992. Battelle will have 2 to 3 people on site for approximately 3 weeks.

Base Support-

The Air Force needs to be able to provide the following:

- Digging permits and utility clearance need to be obtained prior to the initiation of the field work. Underground utilities should be clearly marked to reduce the chance of utility damage or personal injury during soil gas probe and well installation. Due to the fact that both facilities are active fuel pumping systems, and the UST components are FRP, Battelle will not be able to begin field operations without these clearances.
- Electrical power will need to be easily accessible from the project site. The air permeability test and in situ respiration test can be performed using a gasoline powered electric generator. It is desirable that a 50 amp 250 v single phase receptacle be available to plug in our field operations trailer (Hubbell plug cat. # S8269). The operation of the bioventing system will require a permanent 220/110 V power source. If power will not be available immediately after the test is completed the bioventing system will be installed for start-up at a later date.
- Regulatory approval, if any is required, will need to be obtained by the base prior to start-up of the bioventing system. The system will likely be configured for air injection so there will be no point source vapor emission from the system. The wells to be installed will not intersect the apparent water table and no groundwater will be pumped.
- Base and site clearance will be required for Battelle's site employees. We will furnish you with personal information for each person at least one week prior to starting field operations.



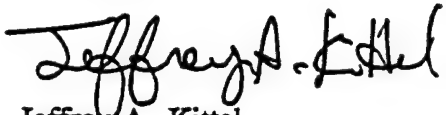
Captain Cathy Vogel  
Tyndall Air Force Base

8

July 13, 1992

Thank you for your support for this bioremediation research project. If you have any questions please feel free to call me at (614) 424-6122.

Sincerely,

A handwritten signature in dark ink, appearing to read "Jeffrey A. Kittel". The signature is fluid and cursive, with the first name "Jeffrey" being the most prominent part.

Jeffrey A. Kittel  
Researcher  
Environmental Technology Department

JAK:sh  
Enclosure

**APPENDIX B**

**ANALYTICAL REPORT FOR FACILITIES 27, 89, AND 14,  
AND THE BACKGROUND AREA**

**AIR TOXICS LTD.**

AN ENVIRONMENTAL ANALYTICAL LABORATORY

**WORK ORDER #: 9208040**

## Work Order Summary

**CLIENT:** Mr. Greg Headington  
Battelle  
505 King Ave.  
Columbus, OH 43201

**BILL TO:** Accounts Payable  
Engineering Science  
1700 Broadway Ste. 900  
Denver, CO 80290

**PHONE:** 614-424-5417

**FAX:** 614-424-3667

**DATE RECEIVED:** 8/11/92

**DATE REPORTED:** 8/14/92

**INVOICE #** 8306

**P.O. #** DE268.03

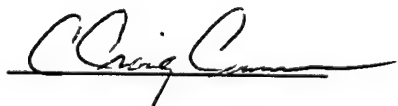
**AMOUNT:** \$551.29

**PROJECT #** G4468-0630

<u>FRACTION #</u>	<u>NAME</u>	<u>TEST</u>	<u>Receipt</u> <u>VAC./Press.</u>	<u>PRICE</u>
01A	N-BG	TO-3	2.0 "Hg	\$120.00
02A	N1-A-6.5	TO-3	1.5 "Hg	\$120.00
03A	N1-V-11.2	TO-3	1.5 "Hg	\$120.00
04A	N1-C-8	TO-3	1.0 "Hg	\$120.00
05A	Lab Blank	TO-3	NA	NC

Misc. Charges	1 Liter SUMMA Canister Preparation (4) @ \$10.00 each.	\$40.00
	Shipping (8/3/92)	\$31.29

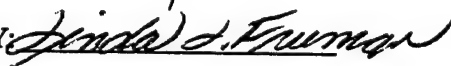
REVIEWED BY:



DATE:

8/18/92

CERTIFIED BY:



DATE:

8/17/92

**AIR TOXICS LTD.**

SAMPLE NAME: N-BG

ID#: 9208040-01A

**EPA Method TO-3**  
(Aromatic Volatile Organics in Air)**BTXE BY GC/PID**

File Name:		6081104	Date of Collection: 8/10/92	
Dil. Factor:		2.2	Date of Analysis: 8/11/92	
Compound	MDL (ppmv)	MDL (uG/L)	Amount (ppmv)	Amount (uG/L)
Benzene	0.002	0.007	Not Detected	Not Detected
Toluene	0.002	0.008	0.002	0.007
Total Xylenes	0.002	0.009	0.002	0.008
Ethyl Benzene	0.002	0.009	Not Detected	Not Detected

**TOTAL PETROLEUM HYDROCARBONS**  
**GC/FID**  
(Quantitated as Jet Fuel)

File Name:		6081104	Date of Collection: 8/10/92	
Dil. Factor:		2.2	Date of Analysis: 8/11/92	
Compound	MDL (ppmv)	MDL (uG/L)	Amount (ppmv)	Amount (uG/L)
TPH*	0.022	0.088	13	52

\*TPH referenced to Jet Fuel (MW=156)

**AIR TOXICS LTD.**

SAMPLE NAME: N1-C-8

ID#: 9208040-04A

**EPA Method TO-3**

(Aromatic Volatile Organics in Air)

**BTXE BY GC/PID**

File Name:		6081110	Date of Collection: 8/10/92	
Dil. Factor:		4.2	Date of Analysis: 8/11/92	
Compound	MDL (ppmv)	MDL (uG/L)	Amount (ppmv)	Amount (uG/L)
Benzene	0.004	0.013	0.005	0.016
Toluene	0.004	0.015	0.006	0.022
Total Xylenes	0.004	0.018	Not Detected	Not Detected
Ethyl Benzene	0.004	0.018	Not Detected	Not Detected

**TOTAL PETROLEUM HYDROCARBONS****GC/FID**

(Quantitated as Jet Fuel)

File Name:		6081110	Date of Collection: 8/10/92	
Dil. Factor:		4.2	Date of Analysis: 8/11/92	
Compound	MDL (ppmv)	MDL (uG/L)	Amount (ppmv)	Amount (uG/L)
TPH*	0.042	0.17	130	520

\*TPH referenced to Jet Fuel (MW=156)

**AIR TOXICS LTD.**

SAMPLE NAME: Lab Blank

ID#: 9208040-05A

**EPA Method TO-3**

(Aromatic Volatile Organics in Air)

**BTXE BY GC/PID**

File Name:		6081103	Date of Collection: NA	
Dil. Factor:		1.0	Date of Analysis: 8/11/92	
Compound	MDL (ppmv)	MDL (uG/L)	Amount (ppmv)	Amount (uG/L)
Benzene	0.001	0.003	Not Detected	Not Detected
Toluene	0.001	0.004	Not Detected	Not Detected
Total Xylenes	0.001	0.004	Not Detected	Not Detected
Ethyl Benzene	0.001	0.004	Not Detected	Not Detected

**TOTAL PETROLEUM HYDROCARBONS****GC/FID**

(Quantitated as Jet Fuel)

File Name:		6081103	Date of Collection: NA	
Dil. Factor:		1.0	Date of Analysis: 8/11/92	
Compound	MDL (ppmv)	MDL (uG/L)	Amount (ppmv)	Amount (uG/L)
TPH*	0.010	0.040	Not Detected	Not Detected

\*TPH referenced to Jet Fuel (MW=156)



**AIR TOXICS LTD.**  
AN ENVIRONMENTAL ANALYTICAL LABORATORY

11325 SUNRISE GOLD CIRCLE, SUITE 'E'  
RANCHO CORDOVA, CA 95742  
(916) 638-9892 • FAX (916) 638-9917

## CHAIN OF CUSTODY RECORD

Page 1 of 1

PROJECT # 64468-0630 PO #           

REMARKS Job No. DE 268.03

ES

COLLECTED BY (Signature) Marilyn Bush, Neg Henry P. Thompson

Alicia

FIELD SAMPLE I.D.# SAMPLING MEDIA (Tenax, Canister etc.)

DATE/TIME

ANALYSIS

VAC./PRESSURE

LAB I.D. #

N-BG	AIR	10 AUG 92 / 1510	BTEX / TVH	2" Hg	12028
N1-A-6.5	AIR	10 AUG 92 / 1500	BTEX / TVH	1.5" Hg	11437
N1-V-11.2	AIR	10 AUG 92 / 1520	BTEX / TVH	1.5" Hg	11431
N1-C-8	AIR	10 AUG 92 / 1530	BTEX / TVH	1" Hg	11434

RELINQUISHED BY: DATE/TIME

RECEIVED BY: DATE/TIME

RELINQUISHED BY: DATE/TIME

RECEIVED BY: DATE/TIME

Doug Z. Hendrich 10 AUG 92 / 1600 C. Areola 8/11/92 9:00 AM

### LAB USE ONLY

SHIPPER NAME

AIR BILL #

OPENED BY: DATE/TIME

TEMP (°C)

CONDITION

REMARKS

**AIR TOXICS LTD.**

AN ENVIRONMENTAL ANALYTICAL LABORATORY

**WORK ORDER #: 9208088**

## Work Order Summary

**CLIENT:** Mr. Jeff Kittel  
Battelle  
505 King Ave.  
Columbus, OH 43201

**BILL TO:** Accounts Payable  
Engineering Science  
1700 Broadway Ste. 900  
Denver, CO 80290

**PHONE:** 614-424-6122

**FAX:** 614-424-3667

**DATE RECEIVED:** 8/21/92

**DATE REPORTED:** 9/1/92

**INVOICE #** 8372

**P.O. #** DE268.03

**AMOUNT:** \$474.64

**PROJECT #** G4468-0630

<u>FRACTION #</u>	<u>NAME</u>	<u>TEST</u>	<u>Receipt</u> <u>VAC./Press.</u>	<u>PRICE</u>
01A	N1-AM-1230	TO-3	0.5 "Hg	\$120.00
02A	N1-EX-1210	TO-3	0 "Hg	\$120.00
03A	N1-EX-1220	TO-3	0.5 "Hg	\$120.00
04A	Lab Blank	TO-3	NA	NC

Misc. Charges	1 Liter SUMMA Canister Preparation (3) @ \$10.00 each.	\$30.00
	Shipping (8/13/92)	\$84.64

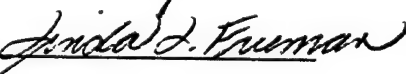
REVIEWED BY:



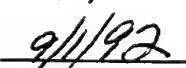
DATE:



CERTIFIED BY:



DATE:





**AIR TOXICS LTD.**

SAMPLE NAME: N1-AM-1230

ID#: 9208088-01A

**EPA Method TO-3**  
(Aromatic Volatile Organics in Air)**BTXE BY GC/PID**

File Name:		6082410	Date of Collection: 8/19/92	
Dil. Factor:		1.4	Date of Analysis: 8/24/92	
Compound	MDL (ppmv)	MDL (uG/L)	Amount (ppmv)	Amount (uG/L)
Benzene	0.001	0.004	Not Detected	Not Detected
Toluene	0.001	0.005	Not Detected	Not Detected
Total Xylenes	0.001	0.006	Not Detected	Not Detected
Ethyl Benzene	0.001	0.006	Not Detected	Not Detected

**TOTAL PETROLEUM HYDROCARBONS**  
**GC/FID**  
(Quantitated as Jet Fuel)

File Name:		6082410	Date of Collection: 8/19/92	
Dil. Factor:		1.4	Date of Analysis: 8/24/92	
Compound	MDL (ppmv)	MDL (uG/L)	Amount (ppmv)	Amount (uG/L)
TPH*	0.014	0.056	0.088	0.35

\*TPH referenced to Jet Fuel (MW=156)

**Comments:**

Total hydrocarbon content reported as TPH but naphtha profile not present. Sample primarily made up of discrete solvents.

**AIR TOXICS LTD.**

SAMPLE NAME: N1-EX-1210

ID#: 9208088-02A

**EPA Method TO-3**  
(Aromatic Volatile Organics in Air)**BTXE BY GC/PID**

File Name:		6082411	Date of Collection: 8/19/92	
Dil. Factor:		1.3	Date of Analysis: 8/24/92	
Compound	MDL (ppmv)	MDL (uG/L)	Amount (ppmv)	Amount (uG/L)
Benzene	0.001	0.004	0.010	0.031
Toluene	0.001	0.004	Not Detected	Not Detected
Total Xylenes	0.001	0.004	Not Detected	Not Detected
Ethyl Benzene	0.001	0.004	Not Detected	Not Detected

**TOTAL PETROLEUM HYDROCARBONS**  
**GC/FID**  
(Quantitated as Jet Fuel)

File Name:		6082411	Date of Collection: 8/19/92	
Dil. Factor:		1.3	Date of Analysis: 8/24/92	
Compound	MDL (ppmv)	MDL (uG/L)	Amount (ppmv)	Amount (uG/L)
TPH*	0.013	0.052	130	520

\*TPH referenced to Jet Fuel (MW=156)

**Comments:**

Total hydrocarbon content reported as TPH but naphtha profile not present. Sample primarily made up of discrete solvents.

**AIR TOXICS LTD.**

SAMPLE NAME: N1-EX-1220

ID#: 9208088-03A

**EPA Method TO-3**

(Aromatic Volatile Organics in Air)

**BTXE BY GC/PID**

File Name:		6082412	Date of Collection: 8/19/92	
Dil. Factor:		6.8	Date of Analysis: 8/24/92	
Compound	MDL (ppmv)	MDL (uG/L)	Amount (ppmv)	Amount (uG/L)
Benzene	0.007	0.021	0.023	0.072
Toluene	0.007	0.025	Not Detected	Not Detected
Total Xylenes	0.007	0.029	Not Detected	Not Detected
Ethyl Benzene	0.007	0.029	Not Detected	Not Detected

**TOTAL PETROLEUM HYDROCARBONS****GC/FID**

(Quantitated as Jet Fuel)

File Name:		6082412	Date of Collection: 8/19/92	
Dil. Factor:		6.8	Date of Analysis: 8/24/92	
Compound	MDL (ppmv)	MDL (uG/L)	Amount (ppmv)	Amount (uG/L)
TPH*	0.068	0.27	55	220

\*TPH referenced to Jet Fuel (MW=156)

**AIR TOXICS LTD.**

SAMPLE NAME: Lab Blank

ID#: 9208088-04A

**EPA Method TO-3**  
(Aromatic Volatile Organics in Air)**BTXE BY GC/PID**

File Name: 6082404		Date of Collection: NA		
Dil. Factor: 1.0		Date of Analysis: 8/24/92		
Compound	MDL (ppmv)	MDL (uG/L)	Amount (ppmv)	Amount (uG/L)
Benzene	0.001	0.003	Not Detected	Not Detected
Toluene	0.001	0.004	Not Detected	Not Detected
Total Xylenes	0.001	0.004	Not Detected	Not Detected
Ethyl Benzene	0.001	0.004	Not Detected	Not Detected

**TOTAL PETROLEUM HYDROCARBONS**  
**GC/FID**  
(Quantitated as Jet Fuel)

File Name: 6082404		Date of Collection: NA		
Dil. Factor: 1.0		Date of Analysis: 8/24/92		
Compound	MDL (ppmv)	MDL (uG/L)	Amount (ppmv)	Amount (uG/L)
TPH*	0.010	0.040	Not Detected	Not Detected

\*TPH referenced to Jet Fuel (MW=156)



# CHAIN OF CUSTODY RECORD

PROJECT # 84468-0630 JOB No. DE-268,03 COLLECTED BY (Signature) Ang. Kavalan  
REMARKS SEND DATA TO: JEFF KITTEL, BATTELLE  
505 KING AVE., Bellingham WA 98201 (614) 424-6122

[illegible]

RELINQUISHED BY: DATE/TIME	RECEIVED BY: DATE/TIME	RELINQUISHED BY: DATE/TIME	RECEIVED BY: DATE/TIME
Dwy Hearn / 19 AUG 92 / 1300		C. Davis / 8/21/92	9:25

**LAB USE ONLY**

SHIPPER NAME	AIR BILL #	OPENED BY: DATE/TIME	TEMP(°C)	CONDITION

REMARKS \_\_\_\_\_

**AIR TOXICS LTD.**

AN ENVIRONMENTAL ANALYTICAL LABORATORY

**WORK ORDER #: 9208087**

## Work Order Summary

**CLIENT:** Mr. Jeff Kittel  
Battelle  
505 King Ave.  
Columbus, OH 43201

**BILL TO:** Accounts Payable  
Engineering Science  
1700 Broadway Ste. 900  
Denver, CO 80290

**PHONE:** 614-424-6122

**FAX:** 614-424-3667

**DATE RECEIVED:** 8/20/92

**DATE REPORTED:** 9/1/92

**INVOICE #** 8370

**P.O. #** DE268.03

**AMOUNT:** \$548.27

**PROJECT #** G4468-0630

<u>FRACTION #</u>	<u>NAME</u>	<u>TEST</u>	<u>Receipt</u> <u>VAC./Press.</u>	<u>PRICE</u>
01A	N2-V-3-10	TO-3	1.0 "Hg	\$120.00
02A	N2-C-9	TO-3	1.0 "Hg	\$120.00
03A	N2-C-6.5	TO-3	1.0 "Hg	\$120.00
04A	N2-AM	TO-3	1.0 "Hg	\$120.00
05A	Lab Blank	TO-3	NA	NC

Misc. Charges	1 Liter SUMMA Canister Preparation (4) @ \$10.00 each.	\$40.00
	Shipping (8/14/92)	\$28.27

REVIEWED BY:

DATE:

CERTIFIED BY:

DATE:

**AIR TOXICS LTD.**

SAMPLE NAME: N2-V-3-10

ID#: 9208087-01A

**EPA Method TO-3**

(Aromatic Volatile Organics in Air)

**BTXE BY GC/PID**

File Name:		6082405	Date of Collection: 8/18/92	
Dil. Factor:		21	Date of Analysis: 8/24/92	
	MDL	MDL	Amount	Amount
Compound	(ppmv)	(uG/L)	(ppmv)	(uG/L)
Benzene	0.021	0.066	Not Detected	Not Detected
Toluene	0.021	0.077	Not Detected	Not Detected
Total Xylenes	0.021	0.089	Not Detected	Not Detected
Ethyl Benzene	0.021	0.089	Not Detected	Not Detected

**TOTAL PETROLEUM HYDROCARBONS  
GC/FID**

(Quantitated as Jet Fuel)

File Name:		6082405		Date of Collection: 8/18/92	
Dil. Factor:		21.0		Date of Analysis: 8/24/92	
		MDL	MDL	Amount	Amount
Compound		(ppmv)	(uG/L)	(ppmv)	(uG/L)
TPH*		0.21	0.84	74	300

\*TPH referenced to Jet Fuel (MW=156)

**AIR TOXICS LTD.**

SAMPLE NAME: N2-C-9

ID#: 9208087-02A

**EPA Method TO-3**

(Aromatic Volatile Organics in Air)

**BTXE BY GC/PID**

File Name:		6082406		Date of Collection:8/18/92	
Dil. Factor:		2.1		Date of Analysis: 8/24/92	
	MDL	MDL	Amount	Amount	
Compound	(ppmv)	(uG/L)	(ppmv)	(uG/L)	
Benzene	0.002	0.007	0.003	0.009	
Toluene	0.002	0.007	0.006	0.019	
Total Xylenes	0.002	0.007	0.004	0.012	
Ethyl Benzene	0.002	0.007	Not Detected	Not Detected	

**TOTAL PETROLEUM HYDROCARBONS****GC/FID**

(Quantitated as Jet Fuel)

File Name:	6082406	Date of Collection:	8/18/92	
Dil. Factor:	2.1	Date of Analysis:	8/24/92	
Compound	MDL (ppmv)	MDL (uG/L)	Amount (ppmv)	Amount (uG/L)
TPH*	0.021	0.084	3.5	14

\*TPH referenced to Jet Fuel (MW=156)



**AIR TOXICS LTD.**

SAMPLE NAME: N2-C-6.5

ID#: 9208087-03A

**EPA Method TO-3**  
(Aromatic Volatile Organics in Air)**BTXE BY GC/PID**

File Name:	6082407		Date of Collection:8/18/92	
Dil. Factor:	2.1		Date of Analysis: 8/24/92	
	MDL	MDL	Amount	Amount
Compound	(ppmv)	(uG/L)	(ppmv)	(uG/L)
Benzene	0.002	0.007	0.008	0.025
Toluene	0.002	0.008	0.027	0.099
Total Xylenes	0.002	0.009	0.012	0.051
Ethyl Benzene	0.002	0.009	0.002	0.008

**TOTAL PETROLEUM HYDROCARBONS**  
**GC/FID**  
(Quantitated as Jet Fuel)

File Name:		6082407		Date of Collection:8/18/92	
Dil. Factor:		2.1		Date of Analysis: 8/24/92	
Compound		MDL (ppmv)	MDL (uG/L)	Amount (ppmv)	Amount (uG/L)
TPH*		0.021	0.084	7.8	31

\*TPH referenced to Jet Fuel (MW=156)

**AIR TOXICS LTD.**

SAMPLE NAME: N2-AM

ID#: 9208087-04A

**EPA Method TO-3**  
(Aromatic Volatile Organics in Air)**BTXE BY GC/PID**

<b>File Name:</b>	<b>6082409</b>	<b>Date of Collection:</b>	<b>8/18/92</b>	
<b>Dil. Factor:</b>	<b>2.1</b>	<b>Date of Analysis:</b>	<b>8/24/92</b>	
	<b>MDL</b>	<b>MDL</b>	<b>Amount</b>	<b>Amount</b>
<b>Compound</b>	<b>(ppmv)</b>	<b>(uG/L)</b>	<b>(ppmv)</b>	<b>(uG/L)</b>
Benzene	0.002	0.007	Not Detected	Not Detected
Toluene	0.002	0.008	Not Detected	Not Detected
Total Xylenes	0.002	0.009	Not Detected	Not Detected
Ethyl Benzene	0.002	0.009	Not Detected	Not Detected

**TOTAL PETROLEUM HYDROCARBONS**  
**GC/FID**  
(Quantitated as Jet Fuel)

<b>File Name:</b>	<b>6082409</b>	<b>Date of Collection:</b>	<b>8/18/92</b>	
<b>Dil. Factor:</b>	<b>2.1</b>	<b>Date of Analysis:</b>	<b>8/24/92</b>	
	<b>MDL</b>	<b>MDL</b>	<b>Amount</b>	<b>Amount</b>
<b>Compound</b>	<b>(ppmv)</b>	<b>(uG/L)</b>	<b>(ppmv)</b>	<b>(uG/L)</b>
TPH*	0.021	0.084	0.44	1.8

\*TPH referenced to Jet Fuel (MW=156)

**AIR TOXICS LTD.**

SAMPLE NAME: Lab Blank

ID#: 9208087-05A

**EPA Method TO-3**  
(Aromatic Volatile Organics in Air)**BTXE BY GC/PID**

File Name:		6082404		Date of Collection: NA	
Dil. Factor:		1.0		Date of Analysis: 8/24/92	
	MDL	MDL	Amount	Amount	
Compound	(ppmv)	(uG/L)	(ppmv)	(uG/L)	
Benzene	0.001	0.003	Not Detected	Not Detected	
Toluene	0.001	0.004	Not Detected	Not Detected	
Total Xylenes	0.001	0.004	Not Detected	Not Detected	
Ethyl Benzene	0.001	0.004	Not Detected	Not Detected	

**TOTAL PETROLEUM HYDROCARBONS**  
**GC/FID**  
(Quantitated as Jet Fuel)

File Name:	6082404	Date of Collection:	NA	
Dil. Factor:	1.0	Date of Analysis:	8/24/92	
Compound	MDL (ppmv)	MDL (uG/L)	Amount (ppmv)	Amount (uG/L)
TPH*	0.010	0.040	Not Detected	Not Detected

\*TPH referenced to Jet Fuel (MW=156)



**AIR TOXICS LTD.**

AN ENVIRONMENTAL ANALYTICAL LABORATORY

11325 SUNRISE GOLD CIRCLE, SUITE 'E'  
RANCHO CORDOVA, CA 95742  
(916) 638-9892 • FAX (916) 638-9917

## CHAIN OF CUSTODY RECORD

Page 1 of 1

PROJECT # 64468-0630 PO # FE-SJ0816 DE268.03 COLLECTED BY (Signature) A Buoh  
REMARKS SEND RESULTS TO: JEFF KIHTEL, BATTERY 11E  
505 KING AVE, COLUMBUS, OH 43201

(614) 424-6122

FIELD SAMPLE I.D.#	SAMPLING MEDIA (Tenax, Canister etc.)	DATE/TIME	ANALYSIS	VAC./PRESSURE	LAB I.D. #
N2-V-3-10	CANISTER 1 liter	18 AUG 92 / 1625	BTEX / TPH	1" Hg	
N2-C-9	CANISTER 1 liter	18 AUG 92 / 1435	BTEX / TPH	1" Hg	
N2-C-6.5	CANISTER 1 liter	18 AUG 92 / 1650		1" Hg	
N2-Am	CANISTER 1 liter	18 AUG 92 / 1700	BTEX / TPH	1" Hg	

RELINQUISHED BY: DATE/TIME Jeff Hendry 18 AUG 92 1800 RECEIVED BY: DATE/TIME C. Asada 8/21/92 8:50  
692 3259 241

### LAB USE ONLY

SHIPPER NAME  AIR BILL #  OPENED BY: DATE/TIME  TEMP (°C)  CONDITION

REMARKS



**ENGINEERING-SCIENCE, INC.**

BERKELEY LABORATORY  
600 BANCROFT WAY  
BERKELEY, CA 94710  
Tel: (415) 841-7353

Report Date: September 9, 1992

Work Order No.: 4231

Client: Jeff Kittel  
Battelle  
505 King Ave.  
Columbus, OH 43201

Date of Sample Receipt: 08/11/92

Your soil samples identified as:

N1-A-4'-4.5'  
N-BKG-4.5'-5.0  
N1-A-8'-9'

were analyzed for BTEX by EPA Method 8020, pH, alkalinity, iron, total kjeldahl nitrogen, soil moisture, TRPH by EPA Method 418.1, soil classification and total phosphorus.

In addition your soil samples identified as:

N2-V-4.3'-4.8'  
N2-V-9.0'-9.5'  
N2-C-10'  
N-BKG-10

were analyzed for BTEX by EPA Method 8020, soil moisture, and TRPH by EPA Method 418.1.

Finally your soil samples identified as:

N2-V-3'-4'  
N2-V-8'-9'  
N-BKG-8.5-9'

were analyzed for pH, alkalinity, iron, total kjeldahl nitrogen, soil moisture, soil classification and total phosphorus.

The analytical reports for the samples listed above are attached.

**AIR TOXICS LTD.**

SAMPLE NAME: N1-A-6.5

ID#: 9208040-02A

**EPA Method TO-3**

(Aromatic Volatile Organics in Air)

**BTXE BY GC/PID**

File Name:		6081105	Date of Collection: 8/10/92	
Dil. Factor:		2.1	Date of Analysis: 8/11/92	
Compound	MDL (ppmv)	MDL (uG/L)	Amount (ppmv)	Amount (uG/L)
Benzene	0.002	0.007	0.046	0.14
Toluene	0.002	0.007	0.008	0.025
Total Xylenes	0.002	0.007	0.003	0.009
Ethyl Benzene	0.002	0.007	Not Detected	Not Detected

**TOTAL PETROLEUM HYDROCARBONS****GC/FID**

(Quantitated as Jet Fuel)

File Name:		6081105	Date of Collection: 8/10/92	
Dil. Factor:		2.1	Date of Analysis: 8/11/92	
Compound	MDL (ppmv)	MDL (uG/L)	Amount (ppmv)	Amount (uG/L)
TPH*	0.021	0.084	2200	8800

\*TPH referenced to Jet Fuel (MW=156)

**AIR TOXICS LTD.**

SAMPLE NAME: N1-V-11.2

ID#: 9208040-03A

**EPA Method TO-3**

(Aromatic Volatile Organics in Air)

**BTXE BY GC/PID**

File Name:		6081107	Date of Collection: 8/10/92	
Dil. Factor:		11	Date of Analysis: 8/11/92	
Compound	MDL (ppmv)	MDL (uG/L)	Amount (ppmv)	Amount (uG/L)
Benzene	0.011	0.034	Not Detected	Not Detected
Toluene	0.011	0.040	0.056	0.21
Total Xylenes	0.011	0.047	0.31	1.3
Ethyl Benzene	0.011	0.047	0.026	0.11

**TOTAL PETROLEUM HYDROCARBONS****GC/FID**

(Quantitated as Jet Fuel)

File Name:		6081107	Date of Collection: 8/10/92	
Dil. Factor:		11	Date of Analysis: 8/11/92	
Compound	MDL (ppmv)	MDL (uG/L)	Amount (ppmv)	Amount (uG/L)
TPH*	0.11	0.44	800	3200

\*TPH referenced to Jet Fuel (MW=156)

-----  
GC ANALYTICAL REPORT  
Analytical Method  
BTEX Aromatic Compounds By 8020

Work Order NO.:4231

% Moisture:14

Client ID:N1A8'-9'

Matrix:SOIL

Laboratory ID:4231-10

Level:LOW

Unit:ug/KG

Dilution Factor: 1

Date Analyzed:08-12-92  
Date Confirmed:NA

=====

Compound

Result

Reporting  
Limit

=====

Benzene

ND

1.0

Ethyl Benzene

ND

2.0

Toluene

ND

2.0


Xylenes (total)

ND

2.0

ND-Not Detected  
NA-Not Applicable  
D-Dilution Factor

ANALYST: LR

GROUP LEADER: 



-----  
GC ANALYTICAL REPORT  
Analytical Method  
BTEX Aromatic Compounds By 8020

Work Order NO.:4231

% Moisture:NA

Client ID:(BLANK)

Matrix:SOIL

Laboratory ID:MSVG3920811

Level:LOW

Unit:ug/KG


Dilution Factor: 1

Date Analyzed:08-11-92  
Date Confirmed:NA-----

Compound	Result	Reporting Limit
-----		
Benzene	ND	1.0
Ethyl Benzene	ND	2.0
Toluene	ND	2.0
Xylenes (total)	ND	2.0

ND-Not Detected  
NA-Not Applicable  
D-Dilution Factor

ANALYST: LR

GROUP LEADER: 

-----  
GC ANALYTICAL REPORT  
Analytical Method  
BTEX Aromatic Compounds By 8020

Work Order NO.:4231

% Moisture:NA

Client ID:(BLANK)

Matrix:SOIL

Laboratory ID:MSVG3920812

Level:LOW

Unit:ug/KG

Dilution Factor: 1

Date Analyzed:08-12-92

Date Confirmed:NA  
=====

Compound

Result

Reporting  
Limit  
=====

Benzene

ND

1.0

Ethyl Benzene

ND

2.0

Toluene

ND

2.0

Xylenes (total)

ND

2.0

ND-Not Detected  
NA-Not Applicable  
D-Dilution FactorANALYST: *LL*GROUP LEADER: *[Signature]*

ES-ENGINEERING SCIENCE, INC.

600 BANCROFT WAY  
BERKELEY, CA 94710

-----  
SURROGATE PERCENTAGE RECOVERY  
BTEX AROMATIC COMPOUNDS BY 8020

MATRIX: SOIL

COLUMN ID: VGC3-VOCOL

=====

LABORATORY NO. a-a-a-TRIFLUOROTOLUENE

=====

MSVG3920811	101
SSVG3920811A	107
SSVG3920811B	98
4231-05 5G	148
4231-07 5G	112
4231-08 5G	110
MSVG3920812	107
4231-01 5G	132
4231-02 5G	112
4231-06 5G	142
4231-10 5G	145

**TPH/GASOLINE DATA PACKAGE**

ES-ENGINEERING SCIENCE, INC.

600 Bancroft Way  
Berkeley, CA 94710

-----  
ORGANIC ANALYTICAL REPORT

Work Order NO.: 4231

Parameter: TPH

Matrix: Soil

Analytical

Unit: mg/Kg

Method: 418.1

Date Extracted: 08/12/92

QC Batch NO.: S92QCB019TPH

Date Analyzed: 08/21/92

-----  
Sample ID:                      Client ID:                      Result      Reporting      Percent  
   Limit      Moisture  
-----  
4231-01                      N2-V4.3'-4.8'                      31                      5                      15.7  
4231-02                      N2-V9.0'-9.5'                      ND                      5                      26.1  
4231-05                      N1A4'-4.5'                      49                      5                      18.2  
4231-06                      N2C10'                      ND                      5                      20.7  
4231-07                      NBKG4.5'-5.0'                      20                      5                      12.9  
4231-08                      NBKG10                      ND                      4                      10.6  
4231-10                      N1A8'-9'                      36                      5                      14.0  
MSTPH920812                      METHOD BLANK                      ND                      4                      NA  
-----

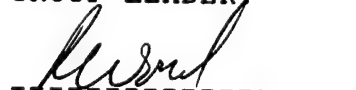
NA\_ Not Analyzed

ND\_ Not Detected

ANALYST:

  
-----

GROUP LEADER:

  
-----

ES-ENGINEERING SCIENCE, INC.

600 Bancroft Way  
Berkeley. CA 94710

-----  
ORGANIC QUALITY CONTROL RESULTS SUMMARY  
Blank Spike/Spike Duplicate

Work Order NO.: 4231

QC Sample NO.: SSTPH920812A & B

Analytical Method: 418.1

Blank I.D.: MSTPH920812

Matrix: Soil

QC Batch NO.: S92QCB019TPH

Unit: mg/Kg


-----  
Parameter      Date  
                 Analyzed      BR      SA      BS      PR      BSD      PR      RPD  
-----  
TPH            08/21/92      0      165      158      96      162      98      3  
-----

BS-Blank Spike  
BSD-Blank Spike Duplicate  
SA-Spike Added  
BR\_Blank Result  
NA-Not Applicable  
NC-Not Calculated  
ND-Not Detected

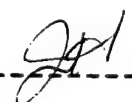
$$RPD = ((BS - BSD) / ((BS + BSD) / 2)) * 100$$

$$PR = ((BS \text{ OR } BSD - BR) / SA) * 100$$

ANALYST:

-----  


QUALITY CONTROL:

-----  


INITIAL CALIBRATION SHEET  
HORIBA OIL CONTENT ANALYZER

METHOD : 418.1

INSTRUMENT SERIES : EXT-5- 920821

STANDARDS PREP REF : LNN-288-75-01, 02, 03, 04, 05

W.O. NO. (S) : 08-21-92

RUN DATE : 08-21-92

CALIBRATION DATA  
STD CONCENTRATIONS IN mg/L

STD 1 = 84 STD 2 = 42 STD 3 = 21 STD 4 = 10 STD 5 = 5

RUN NO.	SAMPLE ID	READINGS (mg/L)				AUG RONG REP 2-5-4
		REP 1	REP 2	REP 3	REP 4	
1	FREON	0	-01	-01		-1
2	std. 1	60	72	72		72
3	std. 2	42	36	36		36
4	std. 3	20	16	16		16
5	std. 4	9	7	7		7
6	std. 5	3	2	2		2

CALIBRATION CURVE : CONC. FOUND =  $m(\text{AUG. RONG}) + b$

WHERE  $m$  = SLOPE OF CURVE = 1.135

$b$  = Y INTERCEPT OF CURVE = 2.022

CORRELATION COEFFICIENT OF LINEAR REGRESSION  $r = 0.9997$

IS  $r$  WITHIN LIMITS ( $r \geq .995$ ) Yes

IF  $r < .995$  REPEAT CALIBRATION WITH FRESH STDs.

COMMENTS :

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

DS 8/24/92

CONTINUING CALIBRATION SHEET  
HORIBA OIL CONTENT ANALYZER

PAGE 1 of 2

METHOD : 48.1

WO NO. (S) : \_\_\_\_\_

INSTRUMENT SERIES : EXT-5- 920821

RUN DATE : 08/11/92

STANDARDS PREP REF : LNN-288- sec int cal  
Verification Std LNN-288-76-01

RUN NO.	SAMPLE ID	DILUT	READINGS (mg/L)				AUG RONG	% DIFF
			REP 1	REP 2	REP 3	REP 4	REP 2+3+4	
7	ICB		-01	-01	-01		-1	
8	ICV		14	16	16	16	16	96 (20.19%)
9	MSTPH920818		-01	-01	-01		-1	
10	SSTPH920812A		25	32	33	33	33	
11	SSTPH920812B		34	34			34	
12	4208-01		467					
13	"	1+14	164	123				
14	"	1+29	55	47	46	46	46	
15	4208-02		229	255				
16	"	1+19	33	22	17	17	17	
17	4208-03		160	181	181			
18	"	1+29	38	16	13	13	13	
19	CCB		-01	-01			-1	
20	CCV		14	16	16		16	96 (20.19%)
21	4213-11		2	-0	-0		0	
22	4231-01		3	4	4		4	
23	-02		0	-01	-01		-1	
24	-05		6	7	7		7	
25	-06		1	0	-01	-01	-1	
26	-07		1	2	2		2	
27	-08		-01	-01	-01		-1	
28	-10		4	5	5		5	
29	MSTPH920818		-02	-02	-02		-2	
30	SSTPH920818A		36	36	36		36	
31	CCB		-01	-02	-02		-2	
32	CCV		12	16	16	16	16	96 (20.19%)
33	SSTPH920818B		35	35	36	36	36	
34	4212-01		5	0	-01	-01	-1	
35	4212-02		4	5	5	5	5	
36	-03		0	0	0		0	
37	4227-01		-02	-02			-2	
38	-02		-01	-01			-1	
39	4235-01		-01	-02	-02		-2	

1. FOR CONTINUING CALIBRATION CHECK<sup>2</sup> ONLY % DIFF =  $\frac{R1-R2}{R1} \times 100$

WHERE R1 IS THE CONCENTRATION OF STD 3 FROM THE INITIAL CALIBRATION  
WHERE R2 IS THE CONCENTRATION OF STD 3 FROM THE CALIBRATION CHECK

IF % DIFF IS >15.0 RECALIBRATE ANALYZER BEFORE RUNNING ANY MORE SAMPLES

2. RUN CONTINUING CALIBRATION AFTER EVERY 10 SAMPLES

✓ DS 8/24/92

COMMENTS :

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CONTINUING CALIBRATION SHEET  
HORIBA OIL CONTENT ANALYZER

PAGE 2 of 2

METHOD : 418.1

WO NO. (S) : \_\_\_\_\_

INSTRUMENT SERIES : EXT-5- 920821

RUN DATE : 08/21/92  
A.L. 08/21/92

STANDARDS PREP REF : Verif. std: 285-76-01

RUN NO.	SAMPLE ID	DILUT	READINGS (mg/L)				AUG RDNG	%1	%1
			REP 1	REP 2	REP 3	REP 4	REP 2+3+4		
40	4235-02		-02	-02			-2		
41	-03		-2	-2			-2		
42	-04		0	0			0		
43	CCB		-2	-2			-2		
44	CCV		12	16	16		16	96	(20.19 mg/L)
45	4235-05		5	4	4		4		
46	-06		465						
47	-06	1+29	140	63	63	63	63		
48	4238-03		7	1	1	1	1		
48	-04		50	62	62		62		
49	-05		11	-1	-1		-1		
50	-06		400						
51	-06	1+29	46	37	37		37		
52	-07		06	0	0		0		
53	4243-01		01	01	01		1		
54	CCB		-2	-2			-2		
55	CCV		12	16	16		16	96	(20.19 mg/L)
56	4243-01 MS		30	34	34		34		
57	-01 MSD		36	36	36		36		
58	-02		03	0	0		0		
59	-03		4	4	4		4		
60	-04		5	5	5		5		
61	MWTPH920819		0	-2	-2		-2		
62	SWTPH920819A		30	31	31		31		
63	SWTPH920819B		31	31	31		31		
64	4212-04		3	-01	-01		-1		
65	4235-07		-2	-2	-2		-2		
66	CCB		-2	-2			-2		
67	CCV		12	16	16		16	96	(20.19 mg/L)
68	4238-01		-2	-2	-2		-2		
69	4243-05		-2	-2			-2		
70	4248-02		-2	-2			-2		
71	CCB		-2	-2			-2		
72	CCV		12	16	16		16	96	(20.19 mg/L)

1. FOR CONTINUING CALIBRATION CHECK? ONLY % DIFF =  $\frac{R1-R2}{R1} \times 100$

WHERE R1 IS THE CONCENTRATION OF STD 3 FROM THE INITIAL CALIBRATION  
WHERE R2 IS THE CONCENTRATION OF STD 3 FROM THE CALIBRATION CHECK

% DIFF IS >15.0 RECALIBRATE ANALYZER BEFORE RUNNING ANY MORE SAMPLES

2. RUN CONTINUING CALIBRATION AFTER EVERY 10 SAMPLES

COMMENTS : \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

MS/24/92

DATA SUMMARY SHEET  
HORIBA OIL CONTENT ANALYZER

PAGE \_\_\_ of \_\_\_

METHOD : 41811

WO NO. (s) : \_\_\_\_\_

INSTRUMENT SERIES : EXT-5- 720821

RUN DATE : 08/21/92

STANDARDS PREP REF : see cal sheet

Q C BATCH # : \_\_\_\_\_

ANALYST : AS / DS

SAMPLE ID	AVG RDNG	CONC FOUND (mg/L)	EXTRACT VOLUME (mls)	DILUT FACTOR	SAMPLE AMOUNT (ml) (gm)	% SOLID	FINAL CONC (mg/Kg)
MSTPH920821	-1	0.89	100.0		25.0	NA	3.55
SSTPH920821A	33	39.49					157.96
SSTPH920821B	34	40.62					162.50
4208-1	46	54.25					
202	17	21.32		30		79.0	8,240.
-3	13	16.78		20		91.8	1,858.
4213-11	0	2.02		30		92.2	2,184.
4231-01	4	6.56	100.0		25.0	NA	8.09
-02	-1	0.89				84.3	31.1
-05	7	9.97				73.9	4.8
-06	-1	0.89				81.8	48.8
-07	2	4.29				79.3	4.49
-08	-1	0.89				87.1	19.7
-10	5	7.70				89.4	3.98
						86.0	35.8

SAMPLE ID	SPIKE ADDED (mg/Kg)	CONC. FOUND (mg/Kg)	PERCENT RECOVERY	RPD
SSTPH920821A	165	158	96	2.9
SSTPH920821B	165	162	98	2.7

COMMENTS : \_\_\_\_\_

QC Review DS 8/21/92

**INORGANICS DATA PACKAGE**

## INORGANICS ANALYTICAL REPORT

Client: ES-Denver  
Project: Newark AFBWork Order: 4231  
Matrix: SolidClient's ID: N2-V N2-V N2-V  
-4.3'-4.8' -9.0'-9.5' -3'-4'Sample Date: 07/31/92 07/31/92 07/31/92  
% Moisture:  
Lab ID: 4231.01 4231.02 4231.03

Parameter	-----Results-----	Method	Normal Report Limit	Units	Date Analyzed
Alkalinity	NR NR 420.	SM 403(M)	50	mg/Kg CaCO3	08/12/92
Moisture	15.7 26.1 15.0	ASTM D2216	.1	% by wt	08/14/92
pH	NR NR 7.8	EPA 9045	NA	pH Units	08/13/92

Note: Samples for alkalinity analysis were extracted using 10mL water for each 1g sample. These water extracts were analyzed for alkalinity, and the results were calculated in the solid on a dry-weight basis.

NA- Not Applicable  
ND- Not Detected  
NR- Analysis Not Requested

ANALYST: Don GleasonGROUP LEADER: Walter S. Long

## INORGANICS ANALYTICAL REPORT

Client: ES-Denver  
Project: Newark AFBWork Order: 4231  
Matrix: SolidClient's ID: N2-V N1-A N2-C  
-8'-9' -4'-4.5' -10'Sample Date: 07/31/92 07/30/92 08/01/92  
% Moisture:  
Lab ID: 4231.04 4231.05 4231.06

Parameter	-----Results-----	Method	Normal Report Limit	Units	Date Analyzed
Alkalinity	490. 410. NR	SM 403(M)	50	mg/Kg CaCO3	08/12/92
Moisture	16.8 18.2 20.7	ASTM D2216	.1	% by wt	08/14/92
pH	7.7 7.7 NR	EPA 9045	NA	pH Units	08/13/92

Note: Samples for alkalinity analysis were extracted using 10mL water for each 1g sample. These water extracts were analyzed for alkalinity, and the results were calculated in the solid on a dry-weight basis.

NA- Not Applicable

ND- Not Detected

NR- Analysis Not Requested

ANALYST: Don SleatonGROUP LEADER: Arthur E. Saly

ES-ENGINEERING-SCIENCE, INC.

600 Bancroft Way  
Berkeley, CA 94710

INORGANICS ANALYTICAL REPORT

Client: ES-Denver  
Project: Newark AFB

Work Order: 4231  
Matrix: Solid

Client's ID: N-BKG N-BKG N-BKG  
-4.5'-5.0' -10 -8.5'-9'

Sample Date: 07/28/92 07/28/92 07/28/92  
% Moisture:  
Lab ID: 4231.07 4231.08 4231.09

Parameter	-----Results-----	Method	Normal Report Limit	Units	Date Analyzed
Alkalinity	36. NR 120.	SM 403(M)	50	mg/Kg CaCO3	08/12/92
Moisture	12.9 10.6 14.7	ASTM D2216	.1	% by wt	08/14/92
pH	6.4 NR 7.4	EPA 9045	NA	pH Units	08/13/92

Note: Samples for alkalinity analysis were extracted using 10mL water for each 1g sample. These water extracts were analyzed for alkalinity, and the results were calculated in the solid on a dry-weight basis.

NA- Not Applicable

ND- Not Detected

NR- Analysis Not Requested

ANALYST: Don Sleator

GROUP LEADER: William S. Pelly

ES-ENGINEERING-SCIENCE, INC.

600 Bancroft Way  
Berkeley, CA 94710

INORGANICS ANALYTICAL REPORT

Client: ES-Denver  
Project: Newark AFB

Work Order: 4231  
Matrix: Solid

Client's ID: N1-A  
-8'-9'

Sample Date: 07/30/92  
% Moisture:  
Lab ID: 4231.10

Parameter	-----Results-----	Method	Normal Report Limit	Units	Date Analyzed
Alkalinity	330.	SM 403(M)	50	mg/Kg CaCO <sub>3</sub>	08/12/92
Moisture	14.0	ASTM D2216	.1	% by wt	08/14/92
pH	7.8	EPA 9045	NA	pH Units	08/13/92

Note: Samples for alkalinity analysis were extracted using 10mL water for each 1g sample. These water extracts were analyzed for alkalinity, and the results were calculated in the solid on a dry-weight basis.

NA- Not Applicable  
ND- Not Detected  
NR- Analysis Not Requested

ANALYST:

Don Gleason

GROUP LEADER:

Arthur J. Sully

## INORGANICS ANALYTICAL REPORT

Client: ES-Denver  
Project: Newark AFBWork Order: 4231  
Matrix: SolidClient's ID: Prep  
Blank

Sample Date:

% Moisture:

Lab ID: Prep Blank

Parameter	-----Results-----	Method	Normal Report Limit	Units	Date Analyzed
Alkalinity	ND	SM 403(M)	50	mg/Kg CaCO <sub>3</sub>	08/12/92
Moisture	NA	ASTM D2216	.1	% by wt	08/14/92
pH	NA	EPA 9045	NA	pH Units	08/13/92

Note: Samples for alkalinity analysis were extracted using 10mL water for each 1g sample. These water extracts were analyzed for alkalinity, and the results were calculated in the solid on a dry-weight basis.

NA- Not Applicable

ND- Not Detected

ANALYST: Don GleasonGROUP LEADER: Walter S. Lee



## INORGANIC QC SUMMARY - MS and MSD

Work Order: 4231

% Moisture: NA

Lab ID Spk/Dup: Alkalinity Moisture pH  
Blank Spk 4235.01 4231.03  
QC Batch: 452.17 451.44 453.22

Matrix: Solid

Units: mg/Kg CaCO3 (Alk)  
% by wt. (Moist)  
pH Units (pH)

Parameter	Date Analyzed MS/Dup	-----Results-----			RPD	RPD QC Limit	-Conc Added-		Percent Recovered	
		Unspiked Sample	MS/Sample	MSD/Dup			MS	MSD	MS	MSD
Alkalinity	08/12/92	0.00	23100.00	23100.00	0	20	23650.00	23650.00	98	98
Moisture	08/14/92		11.92	11.46	4	20				
pH	08/13/92		7.78	7.77	0	20				

\* or N = Outside QC Limit:

QC Limits for % Rec: 75 - 125

ANALYST: Don Gleason  
File: M1QCNSW

Date 8/19/92 REVIEWER: JHDate 8/21/92

**CASE NARRATIVE**  
**WORK ORDER NO. 4231**  
**SOILS - EPA 6010 IRON**

The concentration of iron in sample E1V65 was greater than four times the spike added to the MS and MSD samples. The LCS and duplicate LCS results for iron were checked, and the laboratory was found to be in control. All iron results are therefore reported unqualified.

Client ID's were abridged by the laboratory to facilitate computer entry of analytical data. The following should be used as a reference:

**CLIENT ID**

N2-V-3'-4'  
N2-V-8'-9'  
N1-A-4'-4.5'  
N-BKG-4.5'-5.0'  
N-BKG-8.5'-9'  
N1-A-8'-9'

**ABRIDGED ID**

N2V34  
N2V89  
N1A445  
NBKG4  
NBKG859  
N1A89

**METALS DATA PACKAGE**

CLIENT SAMPLE ID

**N2V34**

Engineering Science - Berkeley Laboratory  
Inorganics Report

CLIENT SAMPLE ID

## INORGANIC ANALYSES DATA SHEET

**N2V89**

Lab Name: E\_S\_\_BERKELEY LABORATORY\_ Contract: AFCEE

Lab Code: ESBL\_\_ Case No.: 4208S SAS No.: \_\_\_\_\_ SDG No.: E1V65

Matrix (soil/water): SOIL\_ Lab Sample ID: 4231.04

Level (low/med):      LOW\_\_      Date Received: 08/11/92

Solids: 83.2

Concentration Units (ug/L or mg/kg as received): MG/KG

[illegible]

---

**Comments:**

FORM I - IN

3/90

CLIENT SAMPLE ID

**N1A445**

Lab Code: ESDL Case No.: 4208S SAS No.: SDG No.: E1V65

Lab Sample ID: 4231.05

Date Received: 08/11/92

Solids: 81.8

Concentration Units (ug/L or mg/kg as received): MG/KG

[illegible]

\_\_\_\_\_

\_\_\_\_\_

**Comments:**

CLIENT SAMPLE ID

**NBKG4**

**GC VOLATILES DATA PACKAGE**



BTEX CASE NARRATIVE  
WORK ORDER NO. 4231  
BTEX-EPA METHOD 8020

These seven soil samples were analyzed for benzene, toluene, ethylbenzene, and xylenes (BTEX) by EPA Methods 8020. ESBL selected compounds and spiking amounts were used for the surrogates and matrix spike/spike duplicates. ESBL QC acceptance criteria were used for the surrogates. ESBL QC acceptance criteria were used for the matrix spike/spike duplicates.

Client ID's were abridged by the laboratory to facilitate computer entry of analytical data. The following should be used as a reference:

<u>CLIENT ID</u>	<u>ABRIDGED ID</u>
N2-V-4.3'-4.8'	N2V4.3'-4.8'
N2-V-9.0'-9.5'	N2V9.0'-9.5'
N1-A-4'-4.5'	N1A4'-4.5'
N2-C-10'	N2C10'
N-BKG-4.5'-5.0	NBKG4
N-BKG-10	NBKG10
N1-A-8'-9'	N1A8'-9'

All samples were analyzed within EPA Data Validation Technical Holding Times.

Two blanks were analyzed with these samples and met method acceptance criteria for surrogates and contamination.

The continuing calibration checks used for quantifying these samples met method acceptance criteria.

All surrogate recoveries were within ESBL acceptance criteria.

GC ANALYTICAL REPORT  
Analytical Method  
BTEx Aromatic Compounds By 8020

Work Order NO.:4231

% Moisture:14

Client ID:N2V4.3'-4.8'

Matrix:SOIL

Laboratory ID:4231-01

Level:LOW

Unit:ug/KG

Dilution Factor: 1

Date Analyzed:08-12-92  
Date Confirmed:NA

Compound	Result	Reporting Limit
Benzene	ND	1.0
Ethyl Benzene	ND	2.0
Toluene	ND	2.0
Xylenes (total)	ND	2.0

ND-Not Detected  
NA-Not Applicable  
D-Dilution Factor

ANALYST: LR

GROUP LEADER: 

-----  
GC ANALYTICAL REPORT  
Analytical Method  
BTEX Aromatic Compounds By 8020

Work Order NO.:4231

% Moisture:26

Client ID:N2V9.0'-9.5'

Matrix:SOIL

Laboratory ID:4231-02

Level:LOW

Unit:ug/KG

Dilution Factor: 1

Date Analyzed:08-12-92

Date Confirmed:NA  
-----

Compound	Result	Reporting Limit
----------	--------	--------------------

-----

Benzene	ND	1.0
Ethyl Benzene	ND	2.0
Toluene	ND	2.0
Xylenes (total)	ND	2.0

ND-Not Detected  
NA-Not Applicable  
D-Dilution FactorANALYST: *LP*GROUP LEADER: *hwa*

-----  
GC ANALYTICAL REPORT  
Analytical Method  
BTEX Aromatic Compounds By 8020

Work Order NO.:4231

% Moisture:18

Client ID:N1A4'-4.5'

Matrix:SOIL

Laboratory ID:4231-05

Level:LOW

Unit:ug/KG

Dilution Factor: 1

Date Analyzed:08-11-92  
Date Confirmed:NA

=====

Compound

Result

Reporting  
Limit

=====

Benzene

ND

1.0

Ethyl Benzene

ND

2.0

Toluene

ND

2.0


Xylenes (total)

ND

2.0

ND-Not Detected  
NA-Not Applicable  
D-Dilution Factor

ANALYST: LR

GROUP LEADER: 

---

GC ANALYTICAL REPORT  
Analytical Method  
BTEX Aromatic Compounds By 8020

Work Order NO.:4231

% Moisture:21

Client ID:N2C10'

Matrix:SOIL

Laboratory ID:4231-06

Level:LOW

Unit:ug/KG

Dilution Factor: 1

Date Analyzed:08-12-92  
Date Confirmed:NA

---

Compound	Result	Reporting Limit
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---

Benzene	ND	1.0
Ethyl Benzene	ND	2.0
Toluene	ND	2.0
Xylenes (total)	ND	2.0

ND-Not Detected  
NA-Not Applicable  
D-Dilution Factor

ANALYST: LR

GROUP LEADER: 

-----  
GC ANALYTICAL REPORT  
Analytical Method  
BTEX Aromatic Compounds By 8020

Work Order NO.:4231

% Moisture:13

Client ID:NBKG4

Matrix:SOIL

Laboratory ID:4231-07

Level:LOW

Unit:ug/KG

Dilution Factor: 1

Date Analyzed:08-11-92

Date Confirmed:NA  
=====

Compound

Result

Reporting  
Limit  
=====

Benzene

ND

1.0

Ethyl Benzene

ND

2.0

Toluene

ND

2.0

Xylenes (total)

ND

2.0

ND-Not Detected  
NA-Not Applicable  
D-Dilution FactorANALYST: *VR*GROUP LEADER: *hmv*

-----  
GC ANALYTICAL REPORT  
Analytical Method  
BTEX Aromatic Compounds By 8020

Work Order NO.:4231

% Moisture:11

Client ID:NBKG10

Matrix:SOIL

Laboratory ID:4231-08

Level:LOW

Unit:ug/KG

Dilution Factor: 1

Date Analyzed:08-11-92  
Date Confirmed:NA-----

Compound	Result	Reporting Limit
Benzene	ND	1.0
Ethyl Benzene	ND	2.0
Toluene	ND	2.0
Xylenes (total)	ND	2.0

-----ND-Not Detected  
NA-Not Applicable  
D-Dilution Factor

ANALYST: LR

GROUP LEADER: *Russell*

9  
ICP SERIAL DILUTION

E1V65 L

Matrix (soil/water): SOIL\_ Level (low/med): LOW\_\_

[illegible]



## PREPARATION LOG

Lab Name: E S BERKELEY LABORATORY

Contract: AFCEE

b Code: ESBL

Case No. : 42085

SAS No.:

SDG No.:E1V65

Method: P

[illegible]

## ANALYSIS RUN LOG

Lab Name: E\_S\_BERKELEY\_LABORATORY\_

Contract: AFCEE\_

Lab Code: ESBL\_ Case No.: 4208S\_

SAS No.: \_ SDG No.: E1V65\_

Instrument ID Number: TJA 61 M\_

Method: P\_

Start Date: 08/17/92

End Date: 08/17/92

EPA Sample No.	D/F	Time	% R	Analytes																	
				F	E																
STD1	1.00	1523		X																	
TD2	1.00	1528		X																	
STD3	1.00	1532		X																	
STD4	1.00	1537		X																	
CV	1.00	1542		X																	
CB	1.00	1546		X																	
ICSA	1.00	1551		X																	
ICSAB	1.00	1556		X																	
RI	1.00	1600																			
PREP BLK	1.00	1605		X																	
ZZZZZZ	1.00	1609																			
CSS	1.00	1614		X																	
CSSD	1.00	1619		X																	
E1V65	1.00	1623		X																	
E1V65_S1	1.00	1628		X																	
E1V65_S2	1.00	1632		X																	
CCV	1.00	1637		X																	
CCB	1.00	1642		X																	
E1V65L	1.00	1646		X																	
E1V7	1.00	1651		X																	
E1V75	1.00	1655		X																	
2V34	1.00	1700		X																	
2V89	1.00	1705		X																	
N1A445	1.00	1709		X																	
BKG4	1.00	1714		X																	
BKG859	1.00	1719		X																	
N1A89	1.00	1723		X																	
CCV	1.00	1728		X																	
CB	1.00	1732		X																	
E1VW14	1.00	1737		X																	
01MPA7	1.00	1742		X																	
1MPB7	1.00	1746		X																	



Proj. No.		Project Title		SAMPLE TYPE (✓)		Container No.	Number of Containers	Remarks
DATE	TIME	DATE	TIME	INORGANIC (physical)	INORGANIC (chemical)			
G4468-0630		NEWARK AFB						
SAMPLERS: (Signature) <u>DON EASTER, GREGORY HEADINGTON</u>								
31 JUL 92		N2-V-4.3'-4.8'		X		28AS	1	
31 JUL 92		N2-V-9.0'-9.5'		X		28AS	1	
31 JUL 92		N2-V-3'-4'		X		1602	1	
31 JUL 92		N2-V-8'-9'		X		1602	1	
31 JUL 92		N2-V-8'-9'		X		802	1	
31 JUL 92		N2-V-3'-4'		X		802	1	
30 JUL 92		N1-A-4'-4.5'		X		28AS	1	
30 JUL 92		N1-A-4'-4.5'		X		1602	1	
30 JUL 92		N1-A-4'-4.5'		X		802	1	
01 AUG 92		N2-C-10'		X		28AS	1	
28 JUL 92		N-BKG-4.5'-5.0'		X		28AS	1	
28 JUL 92		N-BKG-10'		X		28AS	1	
28 JUL 92		N-BKG-4.5'-5.0'		X		802	1	
28 JUL 92		N-BKG-8.5'-9'		X		802	1	
28 JUL 92		N-BKG-4.5'-5'		X		1602	1	
28 JUL 92		N-BKG-8.5'-9'		X		1602	1	

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time
<u>Douglas Headington</u>	10 AUG 92 1700						

Relinquished by: (Signature)	Date/Time	Received for Laboratory by: (Signature)	Date/Time
<u>Douglas Headington</u>	8/11/92 0855	<u>Jeff K'ittel</u>	

Remarks SEND RESULTS TO:

JEFF K'ITTEL  
BATTLE  
505 KING AVE  
COLUMBUS, OH 43201



**TOTAL KJELDAHL NITROGEN**

**TOTAL PHOSPHATE**

**SOIL CLASSIFICATION**

**DATA PACKAGE**



# SEQUOIA ANALYTICAL

680 Chesapeake Drive • Redwood City, CA 94063  
(415) 364-9600 • FAX (415) 364-9233

Engineering Science, Inc.  
600 Bancroft Way  
Berkeley, CA 94710  
Attention: Tom Paulson

Client Project ID: W.O. #4231  
Sample Descript: Soil  
Analysis for: Total Phosphorous  
First Sample #: 208-3076

Sampled: 7/28-31/92  
Received: Aug 14, 1992  
Analyzed: Sep 11, 1992  
Reported: Sep 15, 1992

## LABORATORY ANALYSIS FOR: Total Phosphorous

Sample Number	Sample Description	Detection Limit mg/kg	Sample Result mg/kg
208-3076	N2-V-3'-4'	10	540
208-3077	N2-V-8'-9'	10	540
208-3078	N1-A-4'-4.5'	10	570
208-3079	N-BKG-4.5'-5.0'	10	480
208-3080	N-BKG-8.5'-9'	10	470
208-3081	N1-A-8'-9'	10	460
-	Method Blank	10	N.D.

THIS REPORT HAS BEEN  
APPROVED AND REVIEWED BY

  
ESBL PROJECT MANAGER      9/17/92  
DATE

Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL

  
Tod Granicher  
Project Manager

Please Note:

Analysis results reported on a dry-weight basis.

2083076.ENG <7>



# SEQUOIA ANALYTICAL

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(415) 364-9600 • FAX (415) 364-9233

Engineering Science, Inc.  
600 Bancroft Way  
Berkeley, CA 94710  
Attention: Tom Paulson

Client Project ID: W.O. #4231  
Sample Descript: Soil  
Analysis for: Total Kjeldahl Nitrogen  
First Sample #: 208-3076

Sampled: 7/28-31/92  
Received: Aug 14, 1992  
Analyzed: Aug 25, 1992  
Reported: Sep 15, 1992

## LABORATORY ANALYSIS FOR: Total Kjeldahl Nitrogen

Sample Number	Sample Description	Detection Limit mg/kg	Sample Result mg/kg
208-3076	N2-V-3'-4'	10	450
208-3077	N2-V-8'-9'	10	270
208-3078	N1-A-4'-4.5'	10	300
208-3079	N-BKG-4.5'-5.0'	10	730
208-3080	N-BKG-8.5'-9'	10	300
208-3081	N1-A-8'-9'	10	400
-	Method Blank	0.10	N.D.

Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL

  
Tod Granicher  
Project Manager

Please Note:

Analysis results reported on a dry-weight basis.

2083076.ENG <8>





# SEQUOIA ANALYTICAL

680 Chesapeake Drive • Redwood City, CA 94063  
(415) 364-9600 • FAX (415) 364-9233

Engineering Science, Inc.  
600 Bancroft Way  
Berkeley, CA 94710  
Attention: Tom Paulson

Client Project ID: W.O. #4231

QC Sample Group: 2083076-81

Reported: Sep 15, 1992

## QUALITY CONTROL DATA REPORT

ANALYTE	Total Kjeldahl	Total
	Nitrogen	Phosphorous

Method:	EPA351.4	EPA365.3
Analyst:	G. Kern	K. Follett
Reporting Units:	mg/L	mg/kg
Date Analyzed:	Aug 25, 1992	Apr 11, 1992
QC Sample #:	208-3154	208-3081

Sample Conc.:	640	350
---------------	-----	-----

Spike Conc. Added:	4000	100
-----------------------	------	-----

Conc. Matrix Spike:	4400	460
------------------------	------	-----

Matrix Spike % Recovery:	94	110
-----------------------------	----	-----

Conc. Matrix Spike Dup.:	4400	450
-----------------------------	------	-----

Matrix Spike Duplicate % Recovery:	94	100
--	----	-----

Relative % Difference:	0.0	2.2
---------------------------	-----	-----

SEQUOIA ANALYTICAL

  
Tod Granicher  
Project Manager

% Recovery:	$\frac{\text{Conc. of M.S.} - \text{Conc. of Sample}}{\text{Spike Conc. Added}} \times 100$
Relative % Difference:	$\frac{\text{Conc. of M.S.} - \text{Conc. of M.S.D.}}{(\text{Conc. of M.S.} + \text{Conc. of M.S.D.}) / 2} \times 100$

2083076.ENG <9>



# SEQUOIA ANALYTICAL

680 Chesapeake Drive • Redwood City, CA 94063  
(415) 364-9600 • FAX (415) 364-9233

Engineering Science, Inc.  
600 Bancroft Way  
Berkeley, CA 94710  
Attention: Tom Paulson

Client Project ID: W.O. #4231  
Sample Descript: Soil, N2-V-3'-4'  
Method of Analysis: ASTM D422-63  
Lab Number: 208-3076

Sampled: Jul 31, 1992  
Received: Aug 14, 1992  
Analyzed: Aug 26, 1992  
Reported: Sep 15, 1992

## PARTICLE SIZE DISTRIBUTION BY SIEVE AND HYDROMETER

### SIEVE TEST

- (A) TOTAL WEIGHT OF SAMPLE:  
(B) WEIGHT RETAINED IN NO. 10 SIEVE:  
(C) % PASSING NO. 10 SIEVE:

218.19g
43.98g
79.84%

SIEVE TEST FOR  
WEIGHT RETAINED  
IN NO. 10 SIEVE

IDEAL PAN = 0.0  
IDEAL TOTAL = (B)

SIEVE SIZE	WEIGHT RETAINED, g	% RETAINED	CUMULATIVE % RETAINED	CUMULATIVE % PASSING
1 1/2 in	0.0	0.0	0.0	100
3/8 in	5.98	2.7	2.7	97.3
No. 4	14.59	6.7	9.4	90.6
No. 10	23.31	10.7	20.0	80.0
PAN	0.0			
TOTAL	43.98			

### HYDROMETER TEST

ELAPSED TIME (T)	TEMP. °C	HYDROMETER READING (H)	CORRECTED READING (R)	(L)	PARTICLE DIAM. (S)	% SUSPENDED (P)
2	22	39	35	10.6	0.031	44
5	22	35	31	11.2	0.020	39
10	22	31	27	11.9	0.015	34
15	22	29	25	12.2	0.012	31
25	22	27	23	12.5	0.0094	29
40	22	25	21	12.9	0.0076	26
60	22	23	19	13.2	0.0062	24
90	22	22	18	13.3	0.0051	23
120	22	21	17	13.5	0.0045	21
1440	22	12	8	15.0	0.0014	10

WEIGHT OF SOIL USED IN HYDROMETER TEST (D):  
HYGROSCOPIC MOISTURE CORRECTION FACTOR (G):  
SPECIFIC GRAVITY (ASSUMED):  
DISPERSING AGENT CORRECTION FACTOR (E):  
MENISCUS CORRECTION FACTOR (F):  
TEMP./SPEC. GRAVITY DEPENDANT CONSTANT (K):

65g
0.975
2.65
3
1
0.01332

#### FORMULAS:

$R = H - E - F$   
 $S = K [ \text{SQRT} (L / T) ]$   
 $P = (R / W) 100$   
 $W = (J \cdot 100) / C$   
 $J = D \cdot G$

SEQUOIA ANALYTICAL

Tod Granicher  
Project Manager

CLIENT SAMPLE ID

**NBKG859**

CLIENT SAMPLE ID

N1A89

Solids: 86.0

Concentration Units (ug/L or mg/kg as received): MG/KG

[illegible]

\_\_\_\_\_

\_\_\_\_\_

**Comments:**

CLIENT SAMPLE ID

PREP BLANK

CLIENT SAMPLE ID

E1V65 S1

Contract: AFCEE

SDG No.: E1V65\_

Level (low/med): LOW\_\_

Concentration Units (ug/L or mg/kg dry weight):MG/KG

[illegible]**Comments:**

CLIENT SAMPLE ID

E1V65 S2

Contract: AFCEE

SDG No.: E1V65

Level (low/med): LOW

Solids for Sample: 79.0

Concentration Units (ug/L or mg/kg dry weight):MG/KG

[illegible]**Comments:**

CLIENT SAMPLE ID

E1V65 SD

% Solids for Sample: \_79.0                      % Solids for Duplicate: \_77.6

[illegible]



CLIENT SAMPLE ID

LCSSD

Solids for Sample: 100.0                      % Solids for Duplicate: 100.0

[illegible]



## BLANK SPIKE SAMPLE

Contract: AFCEE\_\_\_\_\_

SAS No.: \_\_\_\_\_ SDG No.: E1V65\_

Solid LCS Source: ESBL-LCSS\_\_\_\_\_

**Queous LCS Source:** \_\_\_\_\_

FORM VII - IN



# SEQUOIA ANALYTICAL

680 Chesapeake Drive • Redwood City, CA 94063  
(415) 364-9600 • FAX (415) 364-9233

Engineering Science, Inc.  
600 Bancroft Way  
Berkeley, CA 94710  
Attention: Tom Paulson

Client Project ID: W.O. #4231  
Sample Descript: Soil, N2-V-8'-9'  
Method of Analysis: ASTM D422-63  
Lab Number: 208-3077

Sampled: Jul 31, 1992  
Received: Aug 14, 1992  
Analyzed: Aug 26, 1992  
Reported: Sep 15, 1992

## PARTICLE SIZE DISTRIBUTION BY SIEVE AND HYDROMETER

### SIEVE TEST

- (A) TOTAL WEIGHT OF SAMPLE:
- (B) WEIGHT RETAINED IN NO. 10 SIEVE:
- (C) % PASSING NO. 10 SIEVE:

198.66g
21.23g
89.31%

SIEVE TEST FOR  
WEIGHT RETAINED  
IN NO. 10 SIEVE

IDEAL PAN = 0.0  
IDEAL TOTAL = (B)

SIEVE SIZE	WEIGHT RETAINED, g	% RETAINED	CUMULATIVE % RETAINED	CUMULATIVE % PASSING
1½in	0.0	0.0	0.0	100
3/8in	0.0	0.0	0.0	100
No.4	2.57	1.3	1.3	98.7
No.10	18.66	9.4	10.7	89.3
PAN	0.0			
TOTAL	21.23			

### HYDROMETER TEST

ELAPSED TIME (T)	TEMP. °C	HYDROMETER READING (H)	CORRECTED READING (R)	(L)	PARTICLE DIAM. (S)	% SUSPENDED (P)
2	22	40	36	10.4	0.030	51
5	22	34	30	11.4	0.020	42
10	22	30	26	12.0	0.015	37
15	22	27	23	12.5	0.012	32
25	22	26	22	12.7	0.0095	31
40	22	24	20	13.0	0.0076	28
60	22	23	19	13.2	0.0062	27
90	22	21	17	13.5	0.0052	24
120	22	21	17	13.5	0.0045	24
1440	22	12	8	15.0	0.0014	11

WEIGHT OF SOIL USED IN HYDROMETER TEST (D):  
 HYGROSCOPIC MOISTURE CORRECTION FACTOR (G):  
 SPECIFIC GRAVITY (ASSUMED):  
 DISPERSING AGENT CORRECTION FACTOR (E):  
 MENISCUS CORRECTION FACTOR (F):  
 TEMP./SPEC. GRAVITY DEPENDANT CONSTANT (K):

65g
0.975
2.65
3
1
0.01332

#### FORMULAS:

$R = H - E - F$   
 $S = K [ \text{SQRT} (L / T) ]$   
 $P = (R / W) 100$   
 $W = (J \cdot 100) / C$   
 $J = D \cdot G$

SEQUOIA ANALYTICAL

Tod Granicher  
Project Manager



# SEQUOIA ANALYTICAL

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(415) 364-9600 • FAX (415) 364-9233

Engineering Science, Inc.  
600 Bancroft Way  
Berkeley, CA 94710  
Attention: Tom Paulson

Client Project ID: W.O. #4231  
Sample Descript: Soil, N1-A-4'-4.5'  
Method of Analysis: ASTM D422-63  
Lab Number: 208-3078

Sampled: Jul 30, 1992  
Received: Aug 14, 1992  
Analyzed: Aug 26, 1992  
Reported: Sep 15, 1992

## PARTICLE SIZE DISTRIBUTION BY SIEVE AND HYDROMETER

### SIEVE TEST

- (A) TOTAL WEIGHT OF SAMPLE:  
(B) WEIGHT RETAINED IN NO. 10 SIEVE:  
(C) % PASSING NO. 10 SIEVE:

165.19g
16.41g
90.07%

SIEVE TEST FOR  
WEIGHT RETAINED  
IN NO. 10 SIEVE

IDEAL PAN = 0.0  
IDEAL TOTAL = (B)

SIEVE SIZE	WEIGHT RETAINED, g	% RETAINED	CUMULATIVE % RETAINED	CUMULATIVE % PASSING
1½in	0.0	0.0	0.0	100
3/8in	6.91	4.2	4.2	95.8
No.4	3.40	2.1	6.3	93.8
No.10	6.10	3.7	10.0	90.1
PAN	0.0			
TOTAL	16.41			

### HYDROMETER TEST

ELAPSED TIME (T)	TEMP. °C	HYDROMETER READING (H)	CORRECTED READING (R)	(L)	PARTICLE DIAM. (S)	% SUSPENDED (P)
2	22	41	37	10.2	0.030	52
5	22	36	32	11.1	0.020	45
10	22	34	30	11.4	0.014	42
15	22	32	28	11.7	0.012	39
25	22	29	25	12.2	0.0083	35
40	22	27	23	12.5	0.0074	32
60	22	26	22	12.7	0.0061	31
90	22	24	20	13.0	0.0051	28
120	22	22	18	13.3	0.0044	25
1440	22	18	14	14.0	0.0013	20

WEIGHT OF SOIL USED IN HYDROMETER TEST (D):  
HYGROSCOPIC MOISTURE CORRECTION FACTOR (G):  
SPECIFIC GRAVITY (ASSUMED):  
DISPERSING AGENT CORRECTION FACTOR (E):  
MENISCUS CORRECTION FACTOR (F):  
TEMP./SPEC. GRAVITY DEPENDANT CONSTANT (K):

65g
0.986
2.65
3
1
0.01332

#### FORMULAS:

$R = H - E - F$   
 $S = K [ \text{SQRT} (L / T) ]$   
 $P = (R / W) 100$   
 $W = (J \cdot 100) / C$   
 $J = D \cdot G$

SEQUOIA ANALYTICAL

  
 Tod Granicher  
 Project Manager



# SEQUOIA ANALYTICAL

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(415) 364-9600 • FAX (415) 364-9233

Engineering Science, Inc.  
600 Bancroft Way  
Berkeley, CA 94710  
Attention: Tom Paulson

Client Project ID: W.O. #4231  
Sample Descript: Soil, N1-A-8'-9'  
Method of Analysis: ASTM D422-63  
Lab Number: 208-3081

Sampled: Jul 30, 1992  
Received: Aug 14, 1992  
Analyzed: Aug 27, 1992  
Reported: Sep 15, 1992

## PARTICLE SIZE DISTRIBUTION BY SIEVE AND HYDROMETER

### SIEVE TEST

- (A) TOTAL WEIGHT OF SAMPLE:  
(B) WEIGHT RETAINED IN NO. 10 SIEVE:  
(C) % PASSING NO. 10 SIEVE:

158.95g
54.27g
65.86%

SIEVE TEST FOR  
WEIGHT RETAINED  
IN NO. 10 SIEVE

IDEAL PAN = 0.0  
IDEAL TOTAL = (B)

SIEVE SIZE	WEIGHT RETAINED, g	% RETAINED	CUMULATIVE % RETAINED	CUMULATIVE % PASSING
1 1/2 in	0.0	0.0	0.0	100
3/8 in	33.74	21.2	21.2	78.8
No. 4	8.19	5.2	26.4	73.6
No. 10	12.34	7.8	34.1	65.9
PAN	0.0			
TOTAL	54.27			

### HYDROMETER TEST

ELAPSED TIME (T)	TEMP. °C	HYDROMETER READING (H)	CORRECTED READING (R)	(L)	PARTICLE DIAM. (S)	% SUSPENDED (P)
2	21	27	23	12.5	0.034	24
5	21	23	19	13.2	0.022	20
10	21	20	16	13.7	0.016	16
15	21	19	15	13.8	0.013	15
25	21	18	14	14.0	0.010	14
40	21	17	13	14.2	0.0080	13
60	21	16	12	14.3	0.0066	12
90	21	15	11	14.5	0.0054	11
120	21	14	10	14.7	0.0047	10
1440	21	12	8	15.0	0.0014	8

WEIGHT OF SOIL USED IN HYDROMETER TEST (D):  
HYGROSCOPIC MOISTURE CORRECTION FACTOR (G):  
SPECIFIC GRAVITY (ASSUMED):  
DISPERSING AGENT CORRECTION FACTOR (E):  
MENISCUS CORRECTION FACTOR (F):  
TEMP./SPEC. GRAVITY DEPENDANT CONSTANT (K):

65g
0.987
2.65
3
1
0.01348

#### FORMULAS:

$$R = H - E - F$$

$$S = K [ \text{SQRT} (L / T) ]$$

$$P = (R / W) 100$$

$$W = (J \cdot 100) / C$$

$$J = D \cdot G$$

SEQUOIA ANALYTICAL

Tod Granicher  
Project Manager



# SEQUOIA ANALYTICAL

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(415) 364-9600 • FAX (415) 364-9233

Engineering Science, Inc.  
600 Bancroft Way  
Berkeley, CA 94710  
Attention: Tom Paulson

Client Project ID: W.O. #4231  
Sample Descript: Soil, N-BKG-4.5'-5.0'  
Method of Analysis: ASTM D422-63  
Lab Number: 208-3079

Sampled: Jul 28, 1992  
Received: Aug 14, 1992  
Analyzed: Aug 26, 1992  
Reported: Sep 15, 1992

## PARTICLE SIZE DISTRIBUTION BY SIEVE AND HYDROMETER

### SIEVE TEST

- (A) TOTAL WEIGHT OF SAMPLE:  
(B) WEIGHT RETAINED IN NO. 10 SIEVE:  
(C) % PASSING NO. 10 SIEVE:

240.72g
75.65g
68.57%

SIEVE TEST FOR  
WEIGHT RETAINED  
IN NO. 10 SIEVE

IDEAL PAN = 0.0  
IDEAL TOTAL = (B)

SIEVE SIZE	WEIGHT RETAINED, g	% RETAINED	CUMULATIVE % RETAINED	CUMULATIVE % PASSING
1½in	0.0	0.0	0.0	100
3/8in	34.96g	14.5	14.5	85.5
No.4	13.58g	5.6	20.2	79.8
No.10	27.11g	11.3	31.4	68.6
PAN	0.0			
TOTAL	75.65g			

### HYDROMETER TEST

ELAPSED TIME (T)	TEMP. °C	HYDROMETER READING (H)	CORRECTED READING (R)	(L)	PARTICLE DIAM. (S)	% SUSPENDED (P)
2	22	29	25	12.2	0.033	27
5	22	26	22	12.7	0.021	24
10	22	23	19	13.2	0.015	20
15	22	21	18	13.3	0.013	19
25	22	19	15	13.8	0.0099	16
40	22	17	13	14.2	0.0079	14
60	22	16	12	14.3	0.0065	13
90	22	15	11	14.5	0.0053	12
120	22	14	10	14.7	0.0047	11
1440	22	11	7	15.2	0.0014	8

WEIGHT OF SOIL USED IN HYDROMETER TEST (D):  
HYGROSCOPIC MOISTURE CORRECTION FACTOR (G):  
SPECIFIC GRAVITY (ASSUMED):  
DISPERSING AGENT CORRECTION FACTOR (E):  
MENISCUS CORRECTION FACTOR (F):  
TEMP./SPEC. GRAVITY DEPENDANT CONSTANT (K):

65g
0.982
2.65
3
1
0.01332

#### FORMULAS:

$R = H - E - F$   
 $S = K [ \text{SQRT} (L / T) ]$   
 $P = (R / W) 100$   
 $W = (J \cdot 100) / C$   
 $J = D \cdot G$

SEQUOIA ANALYTICAL

*Tod Granicher*

Tod Granicher  
Project Manager



# SEQUOIA ANALYTICAL

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(415) 364-9600 • FAX (415) 364-9233

Engineering Science, Inc.  
600 Bancroft Way  
Berkeley, CA 94710  
Attention: Tom Paulson

Client Project ID: W.O. #4231  
Sample Descript: Soil, N-BKG-8.5'-9'  
Method of Analysis: ASTM D422-63  
Lab Number: 208-3080

Sampled: Jul 28, 1992  
Received: Aug 14, 1992  
Analyzed: Aug 27, 1992  
Reported: Sep 15, 1992

## PARTICLE SIZE DISTRIBUTION BY SIEVE AND HYDROMETER

### SIEVE TEST

- (A) TOTAL WEIGHT OF SAMPLE:
- (B) WEIGHT RETAINED IN NO. 10 SIEVE:
- (C) % PASSING NO. 10 SIEVE:

216.47g
77.90g
64.01%

SIEVE TEST FOR  
WEIGHT RETAINED  
IN NO. 10 SIEVE

IDEAL PAN = 0.0  
IDEAL TOTAL = (B)

SIEVE SIZE	WEIGHT RETAINED, g	% RETAINED	CUMULATIVE % RETAINED	CUMULATIVE % PASSING
1 1/2 in	0.0	0.0	0.0	100
3/8 in	28.87	13.3	13.3	86.7
No. 4	26.25	12.1	25.4	74.5
No. 10	22.78	10.5	36.0	64.0
PAN	0.0			
TOTAL	77.90			

### HYDROMETER TEST

ELAPSED TIME (T)	TEMP. °C	HYDROMETER READING (H)	CORRECTED READING (R)	(L)	PARTICLE DIAM. (S)	% SUSPENDED (P)
2	21	36	32	11.1	0.032	32
5	21	31	27	11.9	0.021	27
10	21	27	23	12.5	0.015	23
15	21	25	21	12.9	0.013	21
25	21	23	19	13.2	0.0098	19
40	21	22	18	13.3	0.0078	18
60	21	21	17	13.5	0.0064	17
90	21	19	15	13.8	0.0053	15
120	21	18	14	14.0	0.0046	14
1440	21	15	11	14.5	0.0014	11

WEIGHT OF SOIL USED IN HYDROMETER TEST (D):  
 HYGROSCOPIC MOISTURE CORRECTION FACTOR (G):  
 SPECIFIC GRAVITY (ASSUMED):  
 DISPERSING AGENT CORRECTION FACTOR (E):  
 MENISCUS CORRECTION FACTOR (F):  
 TEMP./SPEC. GRAVITY DEPENDANT CONSTANT (K):

65g
0.972
2.65
3
1
0.01348

#### FORMULAS:

$R = H - E - F$   
 $S = K [ \text{SQRT} (L / T) ]$   
 $P = (R / W) 100$   
 $W = (J \cdot 100) / C$   
 $J = D \cdot G$

SEQUOIA ANALYTICAL

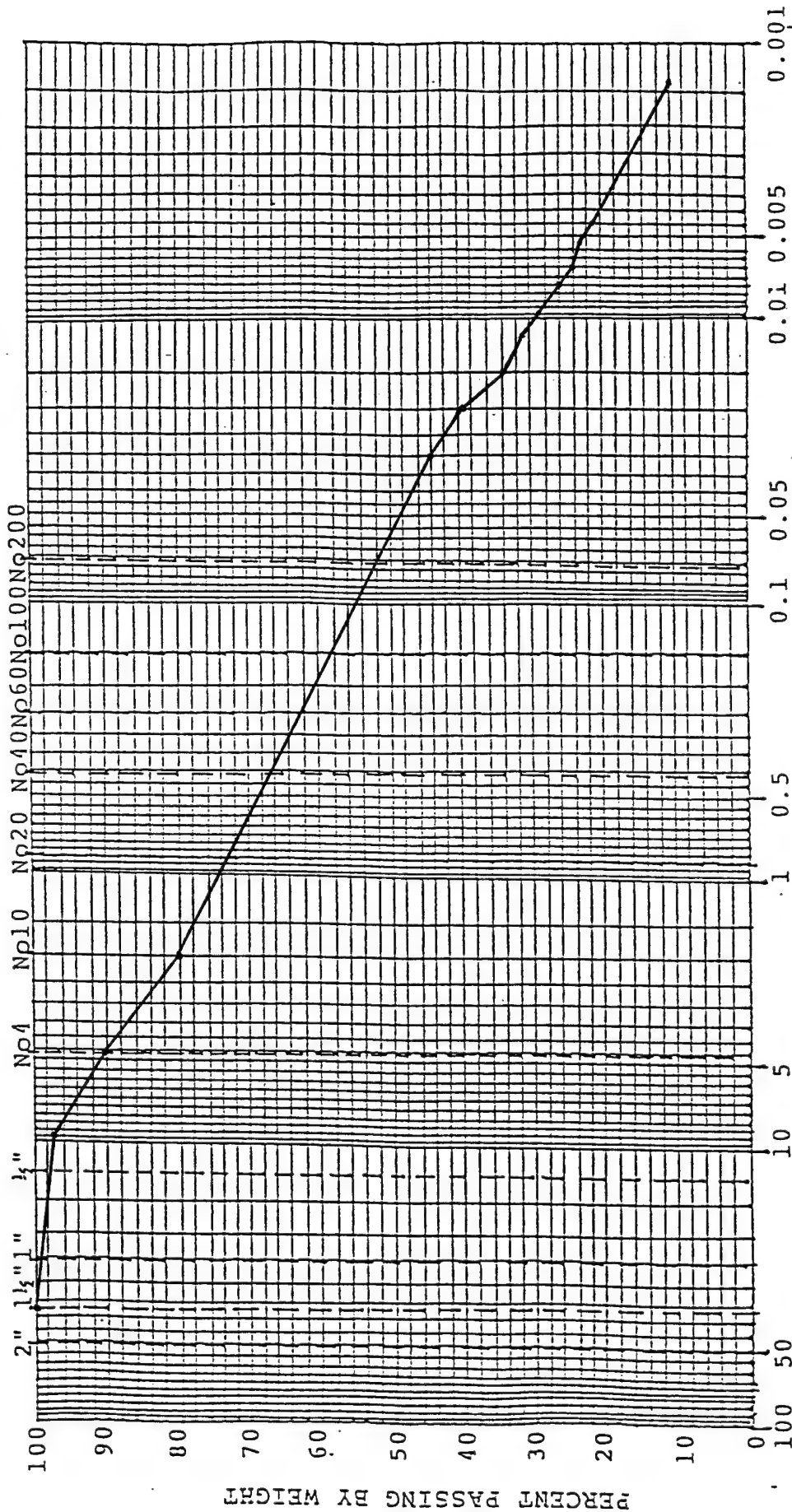
Tod Granicher  
Project Manager



SAMPLE DESCRIPTION: Engineering Science, Inc.

LABORATORY NUMBER: 208-3076

U.S. STANDARD SIEVE SIZES



SAMPLE DESCRIPTION: Engineering Science, Inc.

LABORATORY NUMBER: 208-3077

U.S. STANDARD SIEVE SIZES

No 4 No 10 No 20 No 40 No 60 No 100 No 200

2" 1 1/2" 1" 3/4" 3/8"

100

90

80

70

60

50

40

30

20

10

0

PERCENT PASSING BY WEIGHT

0.001

0.01 0.005

0.05

0.1

0.5

1

5

10

50

100

GRAIN DIAMETER IN MILLIMETERS

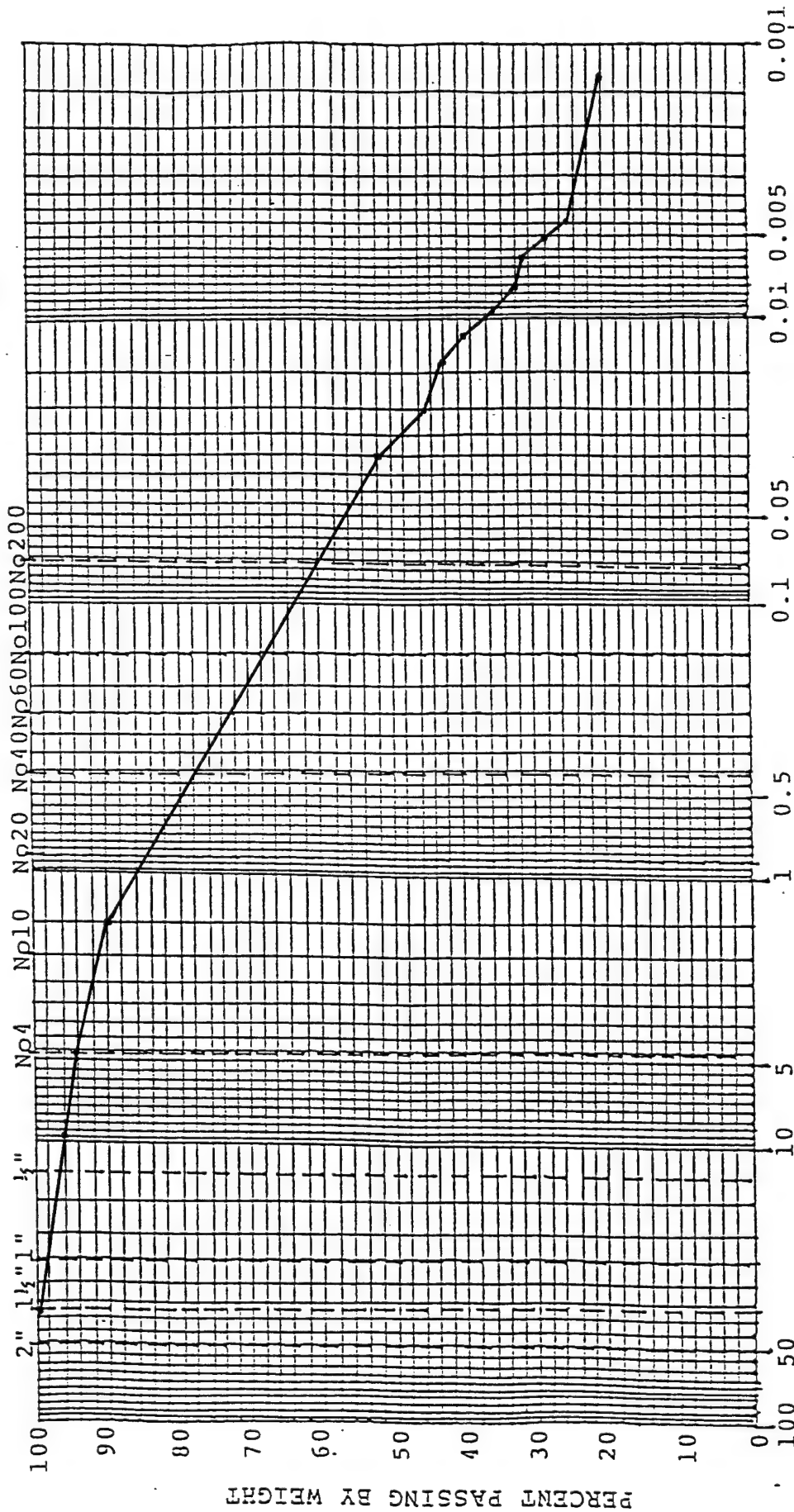
COBBLES	GRAVEL		SAND			FINES	
	COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

SAND	38.7%
SILT	45%
CLAY	15%

SAMPLE DESCRIPTION: Engine

# 0105 007 : VTTION TTYTTON

GRAVEL	6.2%
SAND	33.8%
SILT	38%
CLAY	22%



GRAIN DIAMETER IN MILLIMETERS

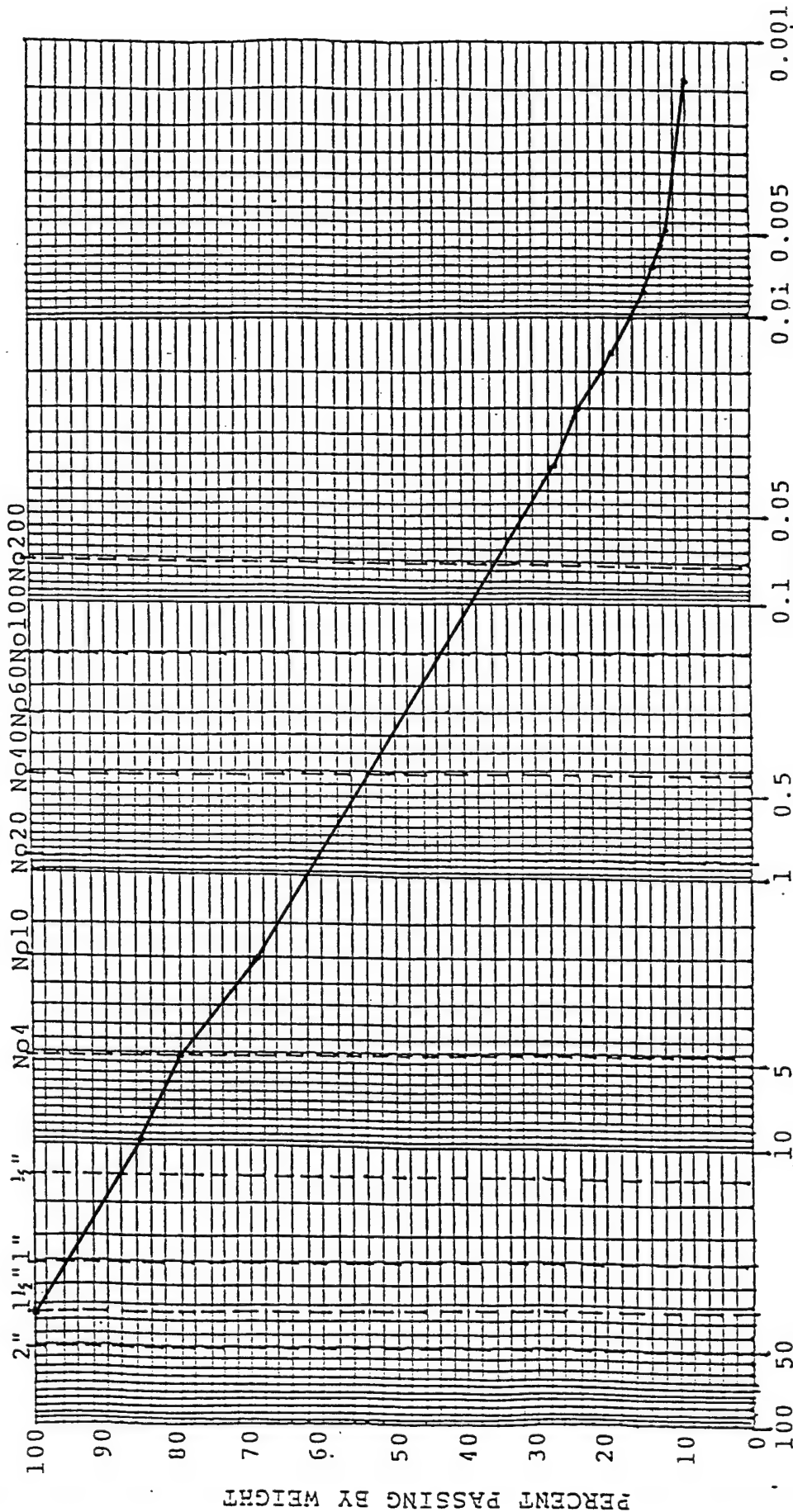
COBBLES	SAND				FINES	
	GRAVEL	FINE	COARSE	MEDIUM	FINE	CLAY SIZES

SAMPLE DESCRIPTION: Engineering Science, Inc.

LABORATORY NUMBER: 208-3079

U.S. STANDARD SIEVE SIZES

SAND	45%
SILT	26%
CLAY	9%



GRAIN DIAMETER IN MILLIMETERS

COBBLES	SAND			FINES	
	COARSE	FINE	COARSE	SILT SIZES	CLAY SIZES



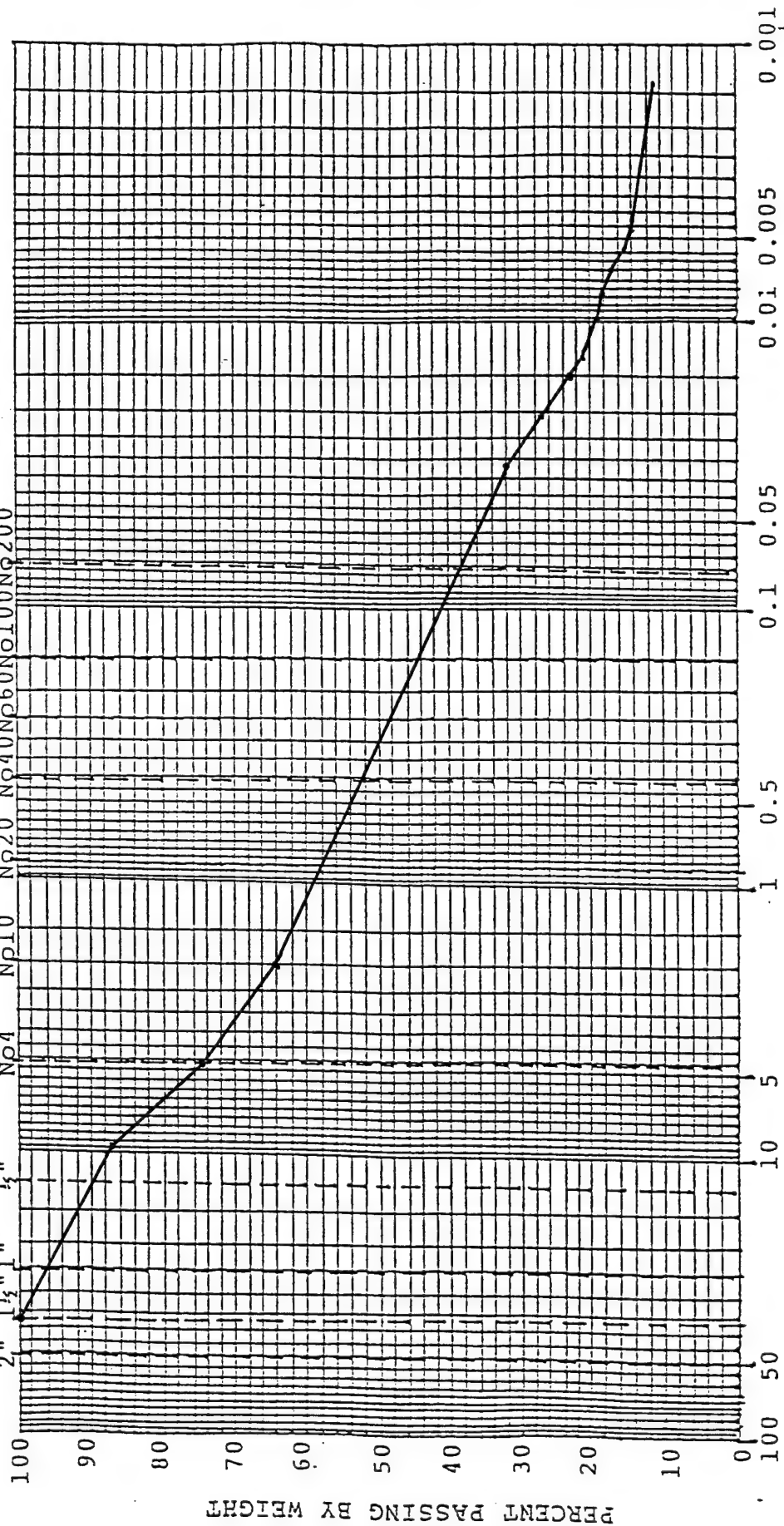
SAMPLE DESCRIPTION: Engineering Science, Inc.

LABORATORY NUMBER: 208-3080

U.S. STANDARD SIEVE SIZES

2" 1 1/2" 1" 3/4" No. 4 No. 10 No. 20 No. 40 No. 60 No. 100 No. 200

GRAVEL	25%
SAND	37%
SILT	26%
CLAY	12%

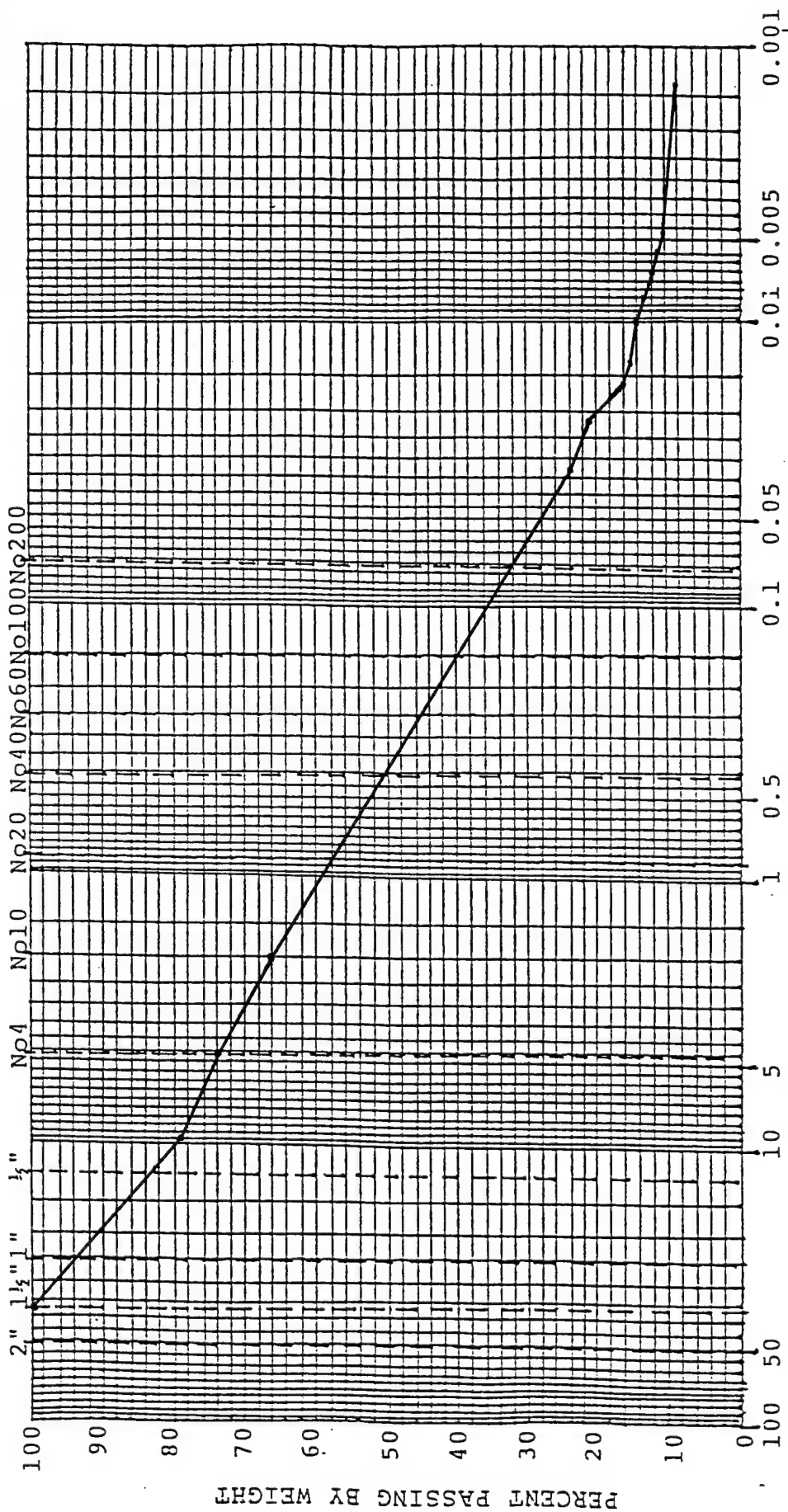


GRAIN DIAMETER IN MILLIMETERS

COBBLES	COARSE	FINE	COARSE	MEDIUM	FINE	FINES	
	GRAVEL		SAND			SILT SIZES	CLAY SIZES

LABORATORY NUMBER: 208-3081

U.S. STANDARD SIEVE SIZES



		GRAIN DIAMETER IN MILLIMETERS					CLAY SIZES
		COARSE	FINE	COARSE	MEDIUM	FINE	
COBBLES							FINES

ASTM-A5CE GRAIN SIZE

## ENGINEERING-SCIENCE

## CHAIN OF CUSTODY RECORD

[illegible]

FIELD CUSTODY RELINQUISHED BY:

DATE: 08/11/92 TIME:

SHIPPED VIA:

AIRBILL #

ON RECEIPT: CUSTODY SEALS?

; TEMP:

RECEIVED FOR LABORATORY BY:

DATE: 8/14/92 TIME: 12:40 PM



**ENGINEERING-SCIENCE, INC.**

BERKELEY LABORATORY  
600 BANCROFT WAY  
BERKELEY, CA 94710  
Tel: (415) 841-7353

Report Date: September 23, 1992

Work Order No.: 4254

Client: Jeff Kittle  
Battelle  
505 King Ave.  
Columbus, OH 43201

Date of Sample Receipt: 8/19/92

Your soil samples identified as:

N3-V-6'-7'

N3-A-2'-3'

N3-A-6'-7'

were analyzed for pH, alkalinity, iron, moisture, total  
kjeldahl nitrogen and total phosphorus.

Finally, your soil samples identified as:

N3-V-7'-7.5

N3-C-7.5'-8

N3-A-2'-3'

N3-A-6'-7'

were analyzed for BTEX by EPA Method 8020, TRPH by EPA Method  
418.1 and soil moisture.

The analytical reports for the samples listed above are  
attached.



**GC VOLATILES DATA PACKAGE**

BTEX CASE NARRATIVE  
WORK ORDER NO. 4254  
EPA METHOD 8020

These four soil and water samples were analyzed for benzene, toluene, ethylbenzene, and xylenes (BTEX) by EPA Methods 8020. QAPjP specified compounds and spiking amounts were used for the surrogates and matrix spike/spike duplicates. ESBL QC acceptance criteria were used for the surrogates. ESBL QC acceptance criteria were for the matrix spike/spike duplicates.

All analytes found at concentrations greater than ESBL reporting limits were quantitated on a second dissimilar column.

All samples were analyzed within EPA Data Validation Technical Holding Times.

Four blanks were analyzed with these samples and met method acceptance criteria for surrogates and contamination.

The continuing calibration checks used for quantifying these samples met method acceptance criteria.

All surrogate recoveries were within ESBL acceptance criteria.

-----  
GC ANALYTICAL REPORT  
Analytical Method  
8020 Aromatic Compounds

Work Order NO.:4254

% Moisture: 14

Client ID:N3-V-7'-7.5

Matrix:SOIL

Laboratory ID:4254-02

Level:LOW

Sample wt./vol : 1 G

Unit:ug/KG

Dilution Factor: 5

Date Analyzed:08/28/92  
Date Confirmed:08/27/92  
-----

Compound	Primary Result	Confirmatory Result	Reporting Limit
Benzene	ND	ND	3.5
Ethyl Benzene	9	49 D-2.5	2.9
Toluene	ND	7100	4.1
Xylenes (total)	64	220 D-2.5	5.2

ND-Not Detected  
NA-Not Applicable  
D-Dilution Factor

ANALYST: LR

GROUP LEADER: *Kerr*

-----  
GC ANALYTICAL REPORT  
Analytical Method  
8020 Aromatic Compounds

Work Order NO.:4254

% Moisture: 15

Client ID:N3-A-2'-3'

Matrix:SOIL

Laboratory ID:4254-04

Level:LOW

Sample wt./vol : 5 G

Unit:ug/KG

Dilution Factor: 1

Date Analyzed:08/26/92

Date Confirmed:08/27/92  
-----

Compound	Primary Result	Confirmatory Result	Reporting Limit
Benzene	ND	ND	0.7
Ethyl Benzene	8	5	0.6
Toluene	ND	ND	0.8
Xylenes (total)	46	20	1.1

ND-Not Detected  
NA-Not Applicable  
D-Dilution Factor

ANALYST: CR

GROUP LEADER: 

-----  
GC ANALYTICAL REPORT  
Analytical Method  
8020 Aromatic Compounds

Work Order NO.:4254

% Moisture: 15

Client ID:N3-A-6'-7'

Matrix:SOIL

Laboratory ID:4254-06

Level:LOW

Sample wt./vol : 5 G

Unit:ug/KG

Dilution Factor: 1

Date Analyzed:08/26/92

Date Confirmed:08/27/92  
-----

Compound	Primary Result	Confirmatory Result	Reporting Limit
Benzene	ND	ND	0.7
Ethyl Benzene	ND	ND	0.6
Toluene	ND	ND	0.8
Xylenes (total)	1.3	1.9	1.1

ND-Not Detected  
NA-Not Applicable  
D-Dilution Factor

ANALYST: LR

GROUP LEADER: 

-----  
GC ANALYTICAL REPORT  
Analytical Method  
8020 Aromatic Compounds

Work Order NO.:4254

% Moisture: 20

Client ID:N3-C-7.5'-8

Matrix:SOIL

Laboratory ID:4254-07

Level:LOW

Sample wt./vol : 5 G

Unit:ug/KG

Dilution Factor: 1

Date Analyzed:08/26/92  
Date Confirmed:NA  
-----

Compound	Primary Result	Confirmatory Result	Reporting Limit
Benzene	ND	ND	0.8
Ethyl Benzene	ND	ND	0.6
Toluene	ND	ND	0.9
Xylenes (total)	ND	ND	1.1

ND-Not Detected  
NA-Not Applicable  
D-Dilution Factor

ANALYST: LR

GROUP LEADER: 

-----  
GC ANALYTICAL REPORT  
Analytical Method  
8020 Aromatic Compounds

Work Order NO.:4254

% Moisture:NA

Client ID:METHOD BLANK

Matrix:SOIL

Laboratory ID:MSVG5920824

Level:LOW

Sample wt./vol : 5 G

Unit:ug/KG

Dilution Factor: 1

Date Analyzed:08/24/92  
Date Confirmed:NA  
-----

Compound	Primary Result	Confirmatory Result	Reporting Limit
Benzene	ND	ND	0.6
Ethyl Benzene	ND	ND	0.5
Toluene	ND	ND	0.7
Xylenes (total)	ND	ND	0.9

ND-Not Detected  
NA-Not Applicable  
D-Dilution Factor

ANALYST: LR

GROUP LEADER: 

-----  
GC ANALYTICAL REPORT  
Analytical Method  
8020 Aromatic Compounds

Work Order NO.:4254

% Moisture:NA

Client ID:METHOD BLANK

Matrix:SOIL

Laboratory ID:MSVG5920826

Level:LOW

Sample wt./vol : 5 G

Unit:ug/KG


Dilution Factor: 1

Date Analyzed:08/26/92  
Date Confirmed:NA  
-----

Compound	Primary Result	Confirmatory Result	Reporting Limit
Benzene	ND	ND	0.6
Ethyl Benzene	ND	ND	0.5
Toluene	ND	ND	0.7
Xylenes (total)	ND	ND	0.9

ND-Not Detected  
NA-Not Applicable  
D-Dilution Factor

ANALYST: LR

GROUP LEADER: 



-----  
GC ANALYTICAL REPORT  
Analytical Method  
8020 Aromatic Compounds

Work Order NO.:4254

% Moisture:NA

Client ID:METHOD BLANK

Matrix:SOIL

Laboratory ID:MSVG5920828

Level:LOW

Sample wt./vol : 5 G

Unit:ug/KG

Dilution Factor: 1

Date Analyzed:08/28/92  
Date Confirmed:NA  
-----

Compound	Primary Result	Confirmatory Result	Reporting Limit
Benzene	ND	ND	0.6
Ethyl Benzene	ND	ND	0.5
Toluene	ND	ND	0.7
Xylenes (total)	ND	ND	0.9

ND-Not Detected  
NA-Not Applicable  
D-Dilution Factor

ANALYST: LR

GROUP LEADER: 

-----  
GC ANALYTICAL REPORT  
Analytical Method  
8020 Aromatic Compounds

Work Order NO.:4254

% Moisture:NA

Client ID:METHOD BLANK

Matrix:SOIL

Laboratory ID:MSVG3920827 CONF.

Level:LOW

Sample wt./vol : 5 G

Unit:ug/KG

Dilution Factor: 1

Date Analyzed:08/27/92  
Date Confirmed:NA-----

Compound	Primary Result	Confirmatory Result	Reporting Limit
-----			
Benzene	ND	ND	0.6
Ethyl Benzene	ND	ND	0.5
Toluene	ND	ND	0.7
Xylenes (total)	ND	ND	0.9

ND-Not Detected  
NA-Not Applicable  
D-Dilution Factor

ANALYST: LR

GROUP LEADER: 

ES-ENGINEERING SCIENCE, INC.

600 BANCROFT WAY  
BERKELEY, CA 94710

-----  
SURROGATE PERCENTAGE RECOVERY  
BTEx AROMATIC COMPOUNDS BY 8020

MATRIX: SOIL

COLUMN ID: VGC5 DB-624  
(Primary column)  
-----

LABORATORY NO. a-a-a-TRIFLUOROTOLUENE  
-----

MSVG5920824	100
MSVG5920824A	99
MSVG5920824B	98
MSVG5920826	98
4254-04 5G	133
4254-06 5G	120
4254-07 5G	114
MSVG5920828	104
4254-02 1G	120

ES-ENGINEERING SCIENCE, INC.

600 BANCROFT WAY  
BERKELEY, CA 94710

-----  
SURROGATE PERCENTAGE RECOVERY  
BTEX AROMATIC COMPOUNDS BY 8020

MATRIX: SOIL

COLUMN ID: VGC3 VOCOL  
(Confirmatory column)

-----  
LABORATORY NO. a-a-a-TRIFLUOROTOLUENE  
-----

MSVG3920827	100
4254-02 2G	99
4254-04 5G	98
4254-06 5G	98

**TOTAL RECOVERABLE PETROLEUM HYDROCARBONS  
DATA PACKAGE**

ES-ENGINEERING SCIENCE, INC.

600 Bancroft Way  
Berkeley, CA 94710

-----  
ORGANIC ANALYTICAL REPORT

Work Order NO.: 4254

Parameter: TPH

Matrix: Soil

Analytical

Unit: mg/Kg

Method: 418.1

Date Extracted: 09/03/92

QC Batch NO.: S92QCB022TPH

Date Analyzed: 09/04/92

-----  
Sample ID: Client ID: Result Reporting Percent  
Limit Moisture  
-----  
4254-02 N3-V-7'-7.5' 350 5 14.1  
4254-04 N3-A-2'-3' 54 5 14.8  
4254-06 N3-A-6'-7' 68 5 15.2  
4254-07 N3-C-7.5'-8' 83 5 19.9  
MSTPH920903 METHOD BLANK ND 4 NA  
-----

NA\_ Not Analyzed  
ND\_ Not Detected

ANALYST:

GROUP LEADER:

-----  


-----  


ES-ENGINEERING SCIENCE, INC.

600 Bancroft Way  
Berkeley. CA 94710

-----  
ORGANIC QUALITY CONTROL RESULTS SUMMARY  
Blank Spike/Spike Duplicate

Work Order NO.: 4254

QC Sample NO.: SSTPH920903A & B

Analytical Method: 418.1

Blank I.D.: MSTPH920903

Matrix: Soil

QC Batch NO.: S92QCB022TPH

Unit: mg/Kg

-----  
Parameter      Date  
                 Analyzed      BR      SA      BS      PR      BSD      PR      RPD  
-----  
TPH            09/04/92      0      165      176      107      176      107      0  
-----

BS-Blank Spike  
BSD-Blank Spike Duplicate  
SA-Spike Added  
BR\_Blank Result  
NA-Not Applicable  
NC-Not Calculated  
ND-Not Detected

$$RPD = ((BS - BSD) / ((BS + BSD) / 2)) * 100$$

$$PR = ((BS \text{ OR } BSD - BR) / SA) * 100$$

ANALYST:

*Slam D*

QUALITY CONTROL:

*MWB*

INITIAL CALIBRATION SHEET  
HQRIBA OIL CONTENT ANALYZER

METHOD : 418.1

INSTRUMENT SERIES : EXT-5- 920904

STANDARDS PREP REF : LMW 284-77-01,2,3,4,5

W.O. NO. (S) : \_\_\_\_\_

RUN DATE : 09-04-92

CALIBRATION DATA  
STD CONCENTRATIONS IN mg/L

STD 1 = 84.0 mg/L STD 2 = 42.0 mg/L STD 3 = 21.0 mg/L STD 4 = 10.0 mg/L STD 5 = 5.0 mg/L

UN. NO.	SAMPLE ID	REP 1	REP 2	REP 3	REP 4	AUG. RONG REP 2-5-4
1	FREON	0	-1	-1		-1
2	std 1	68	80	82	82	82
3	std 2	48	43	42	42	42
4	std 3	24	21	21		21
5	std 4	11	10	10	10	10
6	std 5	6	5	4	4	4
09/04/92	<del>ICB</del> AS 09/04/92					
	<del>ICV</del> AS 09/04/92					

CALIBRATION CURVE : CONC. FOUND =  $m(\text{AUG. RONG}) - b$

WHERE  $m$  = SLOPE OF CURVE = 1.013 ✓

$b$  = Y INTERCEPT OF CURVE = 0.334 ✓

CORRELATION COEFFICIENT OF LINEAR REGRESSION  $r = 0.99957$  ✓  
09/04/92

IS  $r$  WITHIN LIMITS ( $r \geq .995$ ) yes ✓

IF  $r < .995$  REPEAT CALIBRATION WITH FRESH STDs.

COMMENTS : \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

✓  
DS 9/4/92





CONTINUING CALIBRATION SHEET  
HORIBA OIL CONTENT ANALYZER

PAGE 1 OF 1

METHOD : 418.1

WO NO. (S) :

INSTRUMENT SERIES : EXT-5- 920904

RUN DATE : 09-04-92

STANDARDS PREP REF : LNN-288-77-01,02,03,04,05  
VERIFICATION STD. LNN-288-76-01

N NO.	SAMPLE ID	DILUT	READINGS (mg/L)				AUG RDMG	: Red
			REP 1	REP 2	REP 3	REP 4		
	ICB		-1	-1	-1		-1	
8	ICV		16	20	20		20	98% (20.59 mg/L)
	MSTPH920903		-1	-1			-1	
10	SSTPH920903A		36	42	43	43	43	
	SSTPH920903 B		43	43			43	
12	4245-01		12	7	7	7	7	
	-02		4	1	1		1	
14	-03		2	2	2		2	
	-04		2	1	1		1	
16	4254-02		63	73	74	74	74	
	-04		23	12	11	11	11	
18	-06		13	14	14		14	
	CCB		2	-1	-1	-1	-01	
20	CCV		16	20	20		20	98% (20.59 mg/L)
	4254-07		17	16	16	16	16	
22	4288-01		21	22	22		22	
	AS 09-04-92 -03		112					
24	AS 09/04/92 -03	1+1	68	63	62	62	62	
	CCB		7	0	-1	-1	-1	
26	CCV		16	20	20		20	98% (20.59 mg/L)
	MWTPH920904		1	0	0		0	
28	SWTPH920904A		31	36	37	37		
	SWTPH920904B		39	39	39			
30	4257-01		7	3	0	0		
	4261-01		0	0	0			
32	4261-02		0	0	0			
	4263-01		0	0	0			
34	4263-03		0	0	0			
	4263-05		0	0	0			
36	4267-02		0	0	0			
	CCB		0	0	0			
38	CCV		16	18	20	20		
	4267-04		4	0	0			
	4281-01		0	0	0			0 IH 09/04/92

1. FOR CONTINUING CALIBRATION CHECK? ONLY % DIFF =  $\frac{R1-R2}{R1} \times 100$

HERE R1 IS THE CONCENTRATION OF STD 3 FROM THE INITIAL CALIBRATION  
HERE R2 IS THE CONCENTRATION OF STD 3 FROM THE CALIBRATION CHECK

% DIFF IS >15.0 RECALIBRATE ANALYZER BEFORE RUNNING ANY MORE SAMPLES

2. RUN CONTINUING CALIBRATION AFTER EVERY 10 SAMPLES

COMMENTS :

DS 9/4/92

PAGE \_\_\_\_ of \_\_\_\_

METHOD : 418.1

WO NO. (S) : \_\_\_\_\_

INSTRUMENT SERIES : EXT-5-920904

RUN DATE : 09/04/12 09/04/12  
134/12/1

STANDARDS PREP REF : see cal/sheet.

Q C BATCH # : see extract sheet

ANALYST : A-S / OS

[illegible]

COMMENTS : \_\_\_\_\_

QC Review DB 9/4/92

✓ DB 9/4/4-

**INORGANICS DATA PACKAGE**

## INORGANICS ANALYTICAL REPORT

Client: ES-Denver  
Project: Newark AFBWork Order: 4254  
Matrix: SolidClient's ID: N3-V N3-V N3-A  
-6'-7' -7'-7.5' -2'-3'Sample Date: 0950 1015 1115  
08/17/92 08/17/92 08/17/92

% Moisture:

Lab ID: 4254.01 4254.02 4254.03

Parameter	-----Results-----	Method	Normal Report Limit	Units	Date Analyzed
Alkalinity	380. NR 290.	SM 403(M)	50	mg/Kg CaCO3	08/26/92
Moisture	14.6 14.1 10.5	ASTM D2216	.1	% by wt	08/28/92
pH	8.1 NR 7.8	EPA 9045	NA	pH Units	08/28/92

Note: Samples for alkalinity analysis were extracted using 10mL water for each 1g sample. These water extracts were analyzed for alkalinity, and the results were calculated in the solid on a dry-weight basis.

NA- Not Applicable

ND- Not Detected

NR- Analysis Not Requested

ANALYST: Don CleatorGROUP LEADER: William S. Lee

## INORGANICS ANALYTICAL REPORT

Client: ES-Denver  
Project: Newark AFBWork Order: 4254  
Matrix: SolidClient's ID: N3-A N3-A N3-A  
-2'-3' -6'-7' -6'-7'Sample Date: 1130 1135 1150  
08/17/92 08/17/92 08/17/92

% Moisture:

Lab ID: 4254.04 4254.05 4254.06

Parameter	-----Results-----	Method	Normal Report Limit	Units	Date Analyzed	
Alkalinity	NR 280.	NR	SM 403(M)	50	mg/Kg CaCO3	08/26/92
Moisture	14.8 11.4	15.2	ASTM D2216	.1	% by wt	08/28/92
pH	NR 7.8	NR	EPA 9045	NA	pH Units	08/28/92

Note: Samples for alkalinity analysis were extracted using 10mL water for each 1g sample. These water extracts were analyzed for alkalinity, and the results were calculated in the solid on a dry-weight basis.

NA- Not Applicable

ND- Not Detected

NR- Analysis Not Requested

ANALYST: Don SleatorGROUP LEADER: William S. [Signature]

## INORGANICS ANALYTICAL REPORT

Client: ES-Denver  
Project: Newark AFBWork Order: 4254  
Matrix: SolidClient's ID: N3-C  
-7.5'-8'Sample Date: 1500  
08/17/92  
% Moisture:  
Lab ID: 4254.07

Parameter	-----Results-----	Method	Normal Report Limit	Units	Date Analyzed
Alkalinity	NR	SM 403(M)	50	mg/Kg CaCO3	08/26/92
Moisture	19.9	ASTM D2216	.1	% by wt	08/28/92
pH	NR	EPA 9045	NA	pH Units	08/28/92

Note: Samples for alkalinity analysis were extracted using 10mL water for each 1g sample. These water extracts were analyzed for alkalinity, and the results were calculated in the solid on a dry-weight basis.

NA- Not Applicable

ND- Not Detected

NR- Analysis Not Requested

ANALYST: Don KleatorGROUP LEADER: Will S. Sany

## INORGANICS ANALYTICAL REPORT

Client: ES-Denver  
Project: Newark AFBWork Order: 4254  
Matrix: SolidClient's ID: Prep  
Blank

Sample Date:

% Moisture:

Lab ID: Prep Blank

Parameter	-----Results-----	Method	Normal Report Limit	Units	Date Analyzed
Alkalinity	ND	SM 403(M)	50	mg/Kg CaCO <sub>3</sub>	08/26/92
Moisture	NA	ASTM D2216	.1	% by wt	08/28/92
pH	NA	EPA 9045	NA	pH Units	08/28/92

Note: Samples for alkalinity analysis were extracted using 10mL water for each 1g sample. These water extracts were analyzed for alkalinity, and the results were calculated in the solid on a dry-weight basis.

NA- Not Applicable

ND- Not Detected

ANALYST: Don ElestonGROUP LEADER: William J. Kelly



ES-ENGINEERING-SCIENCE, INC.

600 Bancroft Way  
Berkeley, CA 94710

INORGANICS QC SUMMARY - LAB CONTROL SAMPLE

Work Order: 4254 % Moisture: NA  
Lab ID of LCS: Matrix: Solid  
Alkalinity: 452.20 LCS Units: mg/Kg CaCO3

Parameter	Date Analyzed LCS	LCS Result	Conc Added	% Rec LCS	Advisory Limits	
					-- % Rec -- Low	High
Alkalinity	08/26/92	22800.00	23650.00	96	80	120

ANALYST: Don Gleason  
File: M1QCLCSW

Date 9/9/92

REVIEWER: GH

Date 9/10/92

## INORGANIC QC SUMMARY - MS and MSD

Work Order: 4254

% Moisture: NA

Alkalinity Moisture pH  
Lab ID Spk/Dup: Blank Spk 4254.01 4254.01  
QC Batch: 452.20 451.48 453.30

Matrix: Solid

Units: mg/Kg CaCO<sub>3</sub> (Alk)  
% by wt. (Mois)  
pH Units (pH)

Parameter	Date Analyzed MS/Dup	-----Results-----			RPD	RPD QC Limit	-Conc Added-		Percent Recovered	
		Unspiked Sample	MS/Sample	MSD/Dup			MS	MSD	MS	MSD
Alkalinity	08/26/92	0.00	22800.00	22850.00	0	20	23650.00	23650.00	96	97
Moisture	08/28/92		14.60	14.45	1	20				
pH	08/28/92		8.11	8.06	1	20				

\* or N = Outside QC Limit:

QC Limits for % Rec: 75 - 125

ANALYST: Don Elliott Date 9/09/92 REVIEWER: gt  
File: M1QCNSWN

Date 9/10/92

**METALS DATA PACKAGE**

**CASE NARRATIVE**  
**WORK ORDER NO. 4254**  
**METALS - SOILS**

The concentration of iron in sample N3V6-07 was greater than four times the spike added to the MS and MSD samples. The LCS and duplicate LCS results for iron were checked, and the laboratory was found to be in control. All iron results in this batch are therefore reported unqualified based on matrix spike recovery.

Client ID's were abridged by the laboratory to facilitate computer entry of analytical data. The following should be used as a reference:

**CLIENT ID**

N3-V-6'-7'

N3-A-2'-3'

N3-A-6'-7'

**ABRIDGED ID**

N3V6-7

N3A2-3

N3A6-7

CLIENT SAMPLE ID

**N3V6-7**

Engineering Science - Berkeley Laboratory  
Inorganics Report

INORGANIC ANALYSES DATA SHEET

CLIENT SAMPLE ID

N3A2-3

Lab Name: E\_S\_\_BERKELEY\_LABORATORY\_ Contract: AFCEE

Lab Code: ESDL Case No.: 4254S SAS No.: SDG No.: CA40

Matrix (soil/water): SOIL\_ Lab Sample ID: 4254.03

Level (low/med):      LOW\_\_      Date Received: 08/19/92

Solids: 89.5

Concentration Units (ug/L or mg/kg dry weight): MG/KG

[illegible]

Comments:

CLIENT SAMPLE ID

N3A6-7

Concentration Units (ug/L or mg/kg dry weight): MG/KG

[illegible]

\_\_\_\_\_

\_\_\_\_\_

**Comments:**

Engineering Science - Berkeley Laboratory  
Inorganics Report

CLIENT SAMPLE ID

## INORGANIC ANALYSES DATA SHEET

PBLANK

Lab Name: E\_S\_\_BERKELEY\_LABORATORY\_ Contract: AFCEE

Lab Code: ESBL\_\_ Case No.: 4254S SAS No.: \_\_\_\_\_ SDG No.: CA40

Matrix (soil/water): SOIL\_

Lab Sample ID: PBK 460.94

Level (low/med): LOW

Date Received: 09/01/92

■ Solids: 100.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

[illegible]

\_\_\_\_\_

\_\_\_\_\_

**Comments:**

FORM I - IN



CLIENT SAMPLE ID

## SPIKE SAMPLE RECOVERY

**N3V6-7S1**

Contract: AFCEE

**SAS No. :**

SDG No. : CA40

Level (low/med): LOW

% Solids for Sample: 85.4

Concentration Units (ug/L or mg/kg dry weight):MG/KG

[illegible]**Comments:**



CLIENT SAMPLE ID

MATRIX SPIKE DUPLICATE

N3V6-7SD

Lab Name: E\_S\_\_BERKELEY\_LABORATORY\_

Contract: AFCEE

Lab Code: ESBL\_\_

**Case No.: 4254S**

SAS No. : \_\_\_\_\_

SDG No.: CA40\_\_

Matrix (soil/water): SOIL\_

Level (low/med): LOW

% Solids for Sample: 85.4

% Solids for Duplicate: 85.6

Concentration Units (ug/L or mg/kg dry weight):MG/KG

[illegible]

## EPA SAMPLE NO.

N3V6-7L

Matrix (soil/water): SOIL\_ Level (low/med): LOW\_

Concentration Units: ug/L

FORM IX - IN

### Method Detection Limits (Annually)

Furnace AA ID Number : \_\_\_\_\_ (ug/L in 1.00g to 100ml digestate)

[illegible]

Comments:

## PREPARATION LOG

Contract: AFCEE

SDG No. : CA40

**Method:** P\_

FORM XIII - IN

ILMO2.1

Engineering Science - Berkeley Laboratory  
Inorganics Report

ANALYSIS RUN LOG

Lab Name: E\_S\_BERKELEY\_LABORATORY\_

Contract: AFCEE\_\_\_\_\_

Lab Code: ESBL\_ Case No.: 4254S\_

SAS No.: \_\_\_\_\_ SDG No.: CA40\_

Instrument ID Number: TJA 61 M\_

Method: P\_

Start Date: 09/03/92

End Date: 09/03/92

EPA Sample No.	D/F	Time	% R	Analytes																	
				F																	
STD1	1.00	1728		X																	
STD2	1.00	1732		X																	
STD3	1.00	1737		X																	
STD4	1.00	1742		X																	
ICV	1.00	1746		X																	
ICB	1.00	1751		X																	
ICSA	1.00	1756		X																	
ICSAB	1.00	1800		X																	
IRI	1.00	1805																			
PBLANK	1.00	1809		X																	
ZZZZZZ	1.00	1814																			
CSS	1.00	1819		X																	
LCSSD	1.00	1823		X																	
N3V6-7	1.00	1828		X																	
3V6-7S1	1.00	1832		X																	
3V6-7S2	1.00	1837		X																	
CCV	1.00	1842		X																	
CCB	1.00	1846		X																	
3V6-7L	1.00	1851		X																	
N3A2-3	1.00	1855		X																	
N3A6-7	1.00	1900		X																	
A40	1.00	1905		X																	
A60	1.00	1909		X																	
CA90	1.00	1914		X																	
A125	1.00	1919		X																	
A155	1.00	1923		X																	
CCV	1.00	1928		X																	
CCB	1.00	1932		X																	
A180	1.00	1937		X																	
GA240	1.00	1942		X																	
GA255	1.00	1946		X																	
A2115	1.00	1951		X																	





**TOTAL KJELDAHL NITROGEN**

**TOTAL PHOSPHATE**

**DATA PACKAGE**



# SEQUOIA ANALYTICAL

680 Chesapeake Drive • Redwood City, CA 94063  
(415) 364-9600 • FAX (415) 364-9233

Engineering Science, Inc.  
600 Bancroft Way  
Berkeley, CA 94710  
Attention: Tom Paulson

Client Project ID: W.O. #4254  
Sample Descript: Soil  
Analysis for: % Moisture  
First Sample #: 208-3559

Sampled: Aug 17, 1992  
Received: Aug 21, 1992  
Analyzed: Aug 24, 1992  
Reported: Sep 15, 1992

## LABORATORY ANALYSIS FOR: % Moisture

Sample Number	Sample Description	Detection Limit %	Sample Result %
208-3559	N3-V-6'-7'	0.010	17
208-3560	N3-A-2'-3'	0.010	9
208-3561	N3-A-6'-7'	0.010	17

Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL

  
Tod Granicher  
Project Manager

THIS REPORT HAS BEEN  
APPROVED AND REVIEWED BY

  
ESBL PROJECT MANAGER

9/22/92  
DATE



# SEQUOIA ANALYTICAL

680 Chesapeake Drive • Redwood City, CA 94063  
(415) 364-9600 • FAX (415) 364-9233

Engineering Science, Inc.  
600 Bancroft Way  
Berkeley, CA 94710  
Attention: Tom Paulson

Client Project ID: W.O. #4254  
Sample Descript: Soil  
Analysis for: Total Kjeldahl Nitrogen  
First Sample #: 208-3559

Sampled: Aug 17, 1992  
Received: Aug 21, 1992  
Analyzed: Aug 27, 1992  
Reported: Sep 15, 1992

## LABORATORY ANALYSIS FOR: Total Kjeldahl Nitrogen

Sample Number	Sample Description	Detection Limit mg/kg	Sample Result mg/kg
208-3559	N3-V-6'-7'	20	240
208-3560	N3-A-2'-3'	20	240
208-3561	N3-A-6'-7'	20	110
-	Method Blank	0.10	N.D.

Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL

  
Tod Granicher  
Project Manager

Please Note:

Analysis results reported on a dry-weight basis.

2083559.ENG <2>



# SEQUOIA ANALYTICAL

680 Chesapeake Drive • Redwood City, CA 94063  
(415) 364-9600 • FAX (415) 364-9233

Engineering Science, Inc.  
600 Bancroft Way  
Berkeley, CA 94710  
Attention: Tom Paulson

Client Project ID: W.O. #4254  
Sample Descript: Soil  
Analysis for: Total Phosphorous  
First Sample #: 208-3559


Sampled: Aug 17, 1992  
Received: Aug 21, 1992  
Analyzed: Sep 12, 1992  
Reported: Sep 15, 1992

## LABORATORY ANALYSIS FOR: Total Phosphorous

Sample Number	Sample Description	Detection Limit mg/kg	Sample Result mg/kg
208-3559	N3-V-6'-7'	10	270
208-3560	N3-A-2'-3'	10	300
208-3561	N3-A-6'-7'	10	210
-	Method Blank	10	N.D.

Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL

  
Tod Granicher  
Project Manager

Please Note:

Analysis results reported on a dry-weight basis.

2083559.ENG <3>



# SEQUOIA ANALYTICAL

680 Chesapeake Drive • Redwood City, CA 94063  
(415) 364-9600 • FAX (415) 364-9233

Engineering Science, Inc.  
600 Bancroft Way  
Berkeley, CA 94710  
Attention: Tom Paulson

Client Project ID: W.O. #4254

QC Sample Group: 2083559-61

Reported: Sep 15, 1992

## QUALITY CONTROL DATA REPORT

ANALYTE	Total Kjeldahl Nitrogen	Total Phosphorous	% Moisture
---------	----------------------------	----------------------	------------

Method:	EPA351.4	EPA365.3	EPA160.3
Analyst:	G. Kern	K. Follett	Y. Arteaga
Reporting Units:	mg/kg	mg/kg	%
Date Analyzed:	Aug 27, 1992	Sep 12, 1992	Aug 24, 1992
QC Sample #:	208-2430	208-3561	208-3560

Sample Conc.:	49	210	9
---------------	----	-----	---

Spike Conc. Added:	4000	100	N.A.
-----------------------	------	-----	------

Conc. Matrix Spike:	3600	330	N.A.
------------------------	------	-----	------

Matrix Spike % Recovery:	89	120	N.A.
-----------------------------	----	-----	------

Conc. Matrix Spike Dup.:	3600	350	8
-----------------------------	------	-----	---

Matrix Spike Duplicate % Recovery:	89	140	N.A.
--	----	-----	------

Relative % Difference:	0.0	5.9	12
---------------------------	-----	-----	----

SEQUOIA ANALYTICAL

  
Tod Granicher  
Project Manager

% Recovery:	$\frac{\text{Conc. of M.S.} - \text{Conc. of Sample}}{\text{Spike Conc. Added}} \times 100$
Relative % Difference:	$\frac{\text{Conc. of M.S.} - \text{Conc. of M.S.D.}}{(\text{Conc. of M.S.} + \text{Conc. of M.S.D.}) / 2} \times 100$

2083559.ENG <4>

Columbus Laboratories

Proj. No.

Project Title

64468-0636

NEWARK AFB

SAMPLERS: (Signature)

A Bush / G Headington

DATE

TIME

SAMPLE I.D.

17 AUG 92 9:50 13-V-2'-7' @ per 8/2

17 AUG 92 9:50 13-V-1-3'

17 AUG 92 9:50 13-V-6'-7'

17 AUG 92 10:15 13-V-7'-7.5'

17 AUG 92 11:15 13-A-2'-3'

17 AUG 92 11:15 13-A-2'-3'

17 AUG 92 11:30 13-A-2'-3'

17 AUG 92 11:35 13-A-6'-7'

17 AUG 92 11:35 13-A-6'-7'

17 AUG 92 11:50 13-A-6'-7'

17 AUG 92 15:00 13-C-7.5'-8'

SAMPLE TYPE (V)

PH

ALKALINITY

IRON

TOTAL SOIL MOIST.

TOTAL KjELDAHL N

TOTAL Phosphate

BTEX/TPH

Container No.

Number of Containers

Remarks

4oz glass

16oz glass

BRASS tube

4oz glass

16oz glass

BRASS TUBE

4oz glass

16oz glass

BRASS tube

BRASS tube

Add moisture to all samples per Training sheet T Paulson

Relinquished by: (Signature)

Date/Time

Received by: (Signature)

Date/Time

Relinquished by: (Signature)

Date/Time

Received by: (Signature)

Date/Time

Received by: (Signature)

Relinquished by: (Signature)

Date/Time

Received by: (Signature)

Date/Time

Relinquished by: (Signature)

Date/Time

Received by: (Signature)

Date/Time

Received by: (Signature)

Relinquished by: (Signature)

Date/Time

Received for Laboratory by: (Signature)

Date/Time

Relinquished by: (Signature)

Date/Time

Remarks

Send Results to Temp. 30

JEFF KITTEL

Battelle

## CHAIN OF CUSTODY RECORD

[illegible]

26/10/82 and 50.2  
 1:45 AFFORD

**APPENDIX C**

**FACILITY 27 SOIL GAS PERMEABILITY DATA**



Table C-1. Results of Soil Gas Permeability Test at Monitoring Point N1-MPA

Time (min)	Pressure ("H <sub>2</sub> O) by Depth			Time (min)	Pressure ("H <sub>2</sub> O) by Depth		
	4.0'	6.5'	9.0'		4.0'	6.5'	9.0'
0	0			14	0.015	1.22	1.23
1	<0	1.24	1.25	16	0.005	1.22	1.23
2	0.01	1.25	1.25	18	0.005	1.23	1.23
3	0.015	1.25	1.25	20	0.005	1.23	1.23
5	0.65	1.23	1.24	22	0.005	1.24	1.00
6	1.00	1.24	1.24	24	0.005	1.24	1.00
7	0.064	1.00	1.20	27	0.005	1.23	1.00
8.25	0.85	1.22	1.23	30	0.005	1.22	1.22
9.25	0.85	1.22	1.22	33	0.005	1.23	1.21
12	0.11	1.22	1.22	36	0	1.235	1.21

**Table C-1. Results of Soil Gas Permeability Test at Monitoring Point N1-MPA (Continued)**

Time (min)	Pressure ("H <sub>2</sub> O) by Depth		
	4.0'	6.5'	9.0'
39	0	1.23	1.21
42	0	1.24	1.215
45	0	1.235	1.22
48	0	1.24	1.225
51	0	1.235	1.22
54	0	1.24	1.23
57	0	1.24	1.23
60	0	1.24	1.23
65	0	1.24	1.23
70	0	1.25	1.22
75	0	1.25	1.25
85	0	1.25	1.25
95	0	1.25	1.25
115	0	1.25	1.25

Table C-2. Results of Soil Gas Permeability Test at Monitoring Point N1-MPB

Time (min)	Pressure ("H <sub>2</sub> O) by Depth			Time (min)	Pressure ("H <sub>2</sub> O) by Depth		
	4.0'	6.5'	9.0'		4.0'	6.5'	9.0'
0	0.01	0.01	0	12	0	0.128	0.13
1	0.02	0.14	0.145	14	0	0.132	0.137
2	0.015	0.14	0.145	16	0	0.135	0.135
3	0.005	0.135	0.140	18	0.005	0.125	0.13
4	0.005	0.14	0.14	20	0	0.132	0.135
5	0.002	0.135	0.135	23	0.003	0.125	0.127
6	0	0.125	0.125	26	0	0.13	0.13
7	<0	0.125	0.125	29	0.002	0.13	0.132
8	<0	0.120	0.127	32	0.005	0.13	0.13
9	<0	0.123	0.125	35	0	0.13	0.132
10	<0	0.127	0.13	38	0.01	0.138	0.14

**Table C-2. Results of Soil Gas Permeability Test at Monitoring Point N1-MPB (Continued)**

Time (min)	Pressure ("H <sub>2</sub> O) by Depth		
	4.0'	6.5'	9.0'
41	0.005	0.125	0.127
44	0	0.13	0.135
47	0	0.125	0.135
50	0	0.13	0.13
60	0	0.135	0.135
70	0.005	0.135	0.135
80	0.02	0.13	0.13
90	0.013	0.13	0.13
100	0.01	0.13	0.13
110	0.02	0.137	0.137
120	0.015	0.135	0.135

Table C-3. Results of Soil Gas Permeability Test at Monitoring Point N1-MPC

Time (min)	Pressure ("H <sub>2</sub> O) by Depth			Time (min)	Pressure ("H <sub>2</sub> O) by Depth		
	2.7'	5.0'	8.0'		2.7'	5.0'	8.0'
0	<0	<0	<0	21	<0	<0	<0
1	<0	<0	<0	26	<0	<0	<0
1.5	<0	<0	<0	36	<0	<0	<0
2	<0	<0	<0	41	<0	<0	<0
2.5	<0	<0	<0	46	<0	<0	<0
3	<0	<0	<0	56	<0	<0	<0
4	<0	<0	<0	66	<0	<0	<0
6	<0	<0	<0	76	<0	<0	<0
8	<0	<0	<0	106	<0	<0	<0
10	<0	<0	<0	136	<0	<0	<0
12	<0	<0	<0				
14	<0	<0	<0				
16	<0	<0	<0				

**APPENDIX D**

**FACILITY 27 IN SITU RESPIRATION TEST DATA**

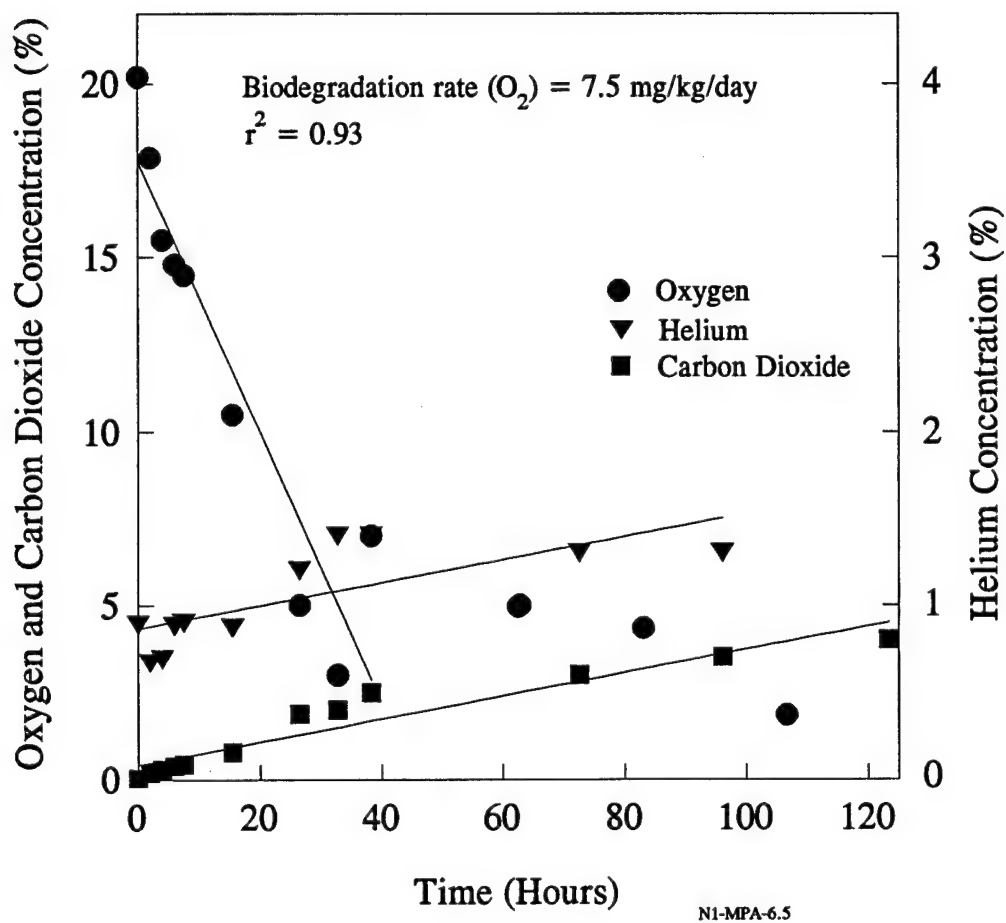


Figure D-1. Oxygen Utilization and Carbon Dioxide Production During the In Situ Respiration Test at Monitoring Point N1-MPA-6.5'

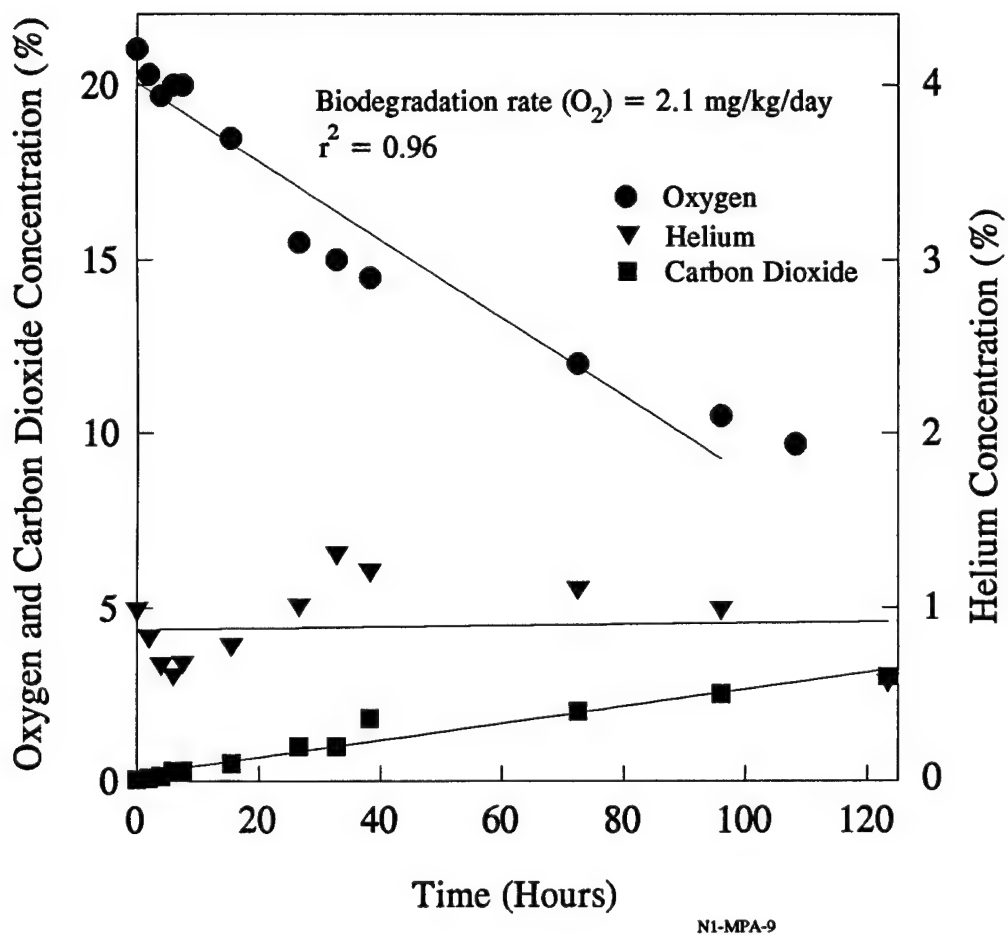


Figure D-2. Oxygen Utilization and Carbon Dioxide Production During the In Situ Respiration Test at Monitoring Point N1-MPA-9.0'



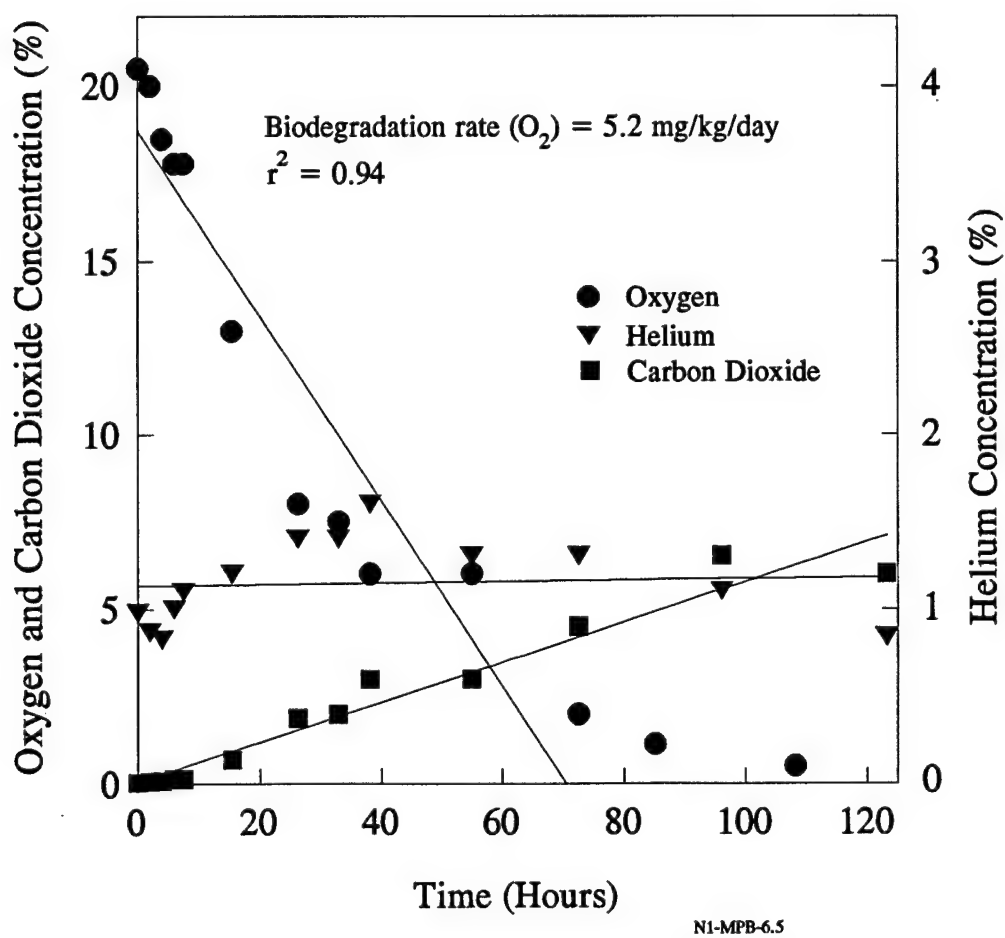


Figure D-3. Oxygen Utilization and Carbon Dioxide Production During the In Situ Respiration Test at Monitoring Point N1-MPB-6.5'

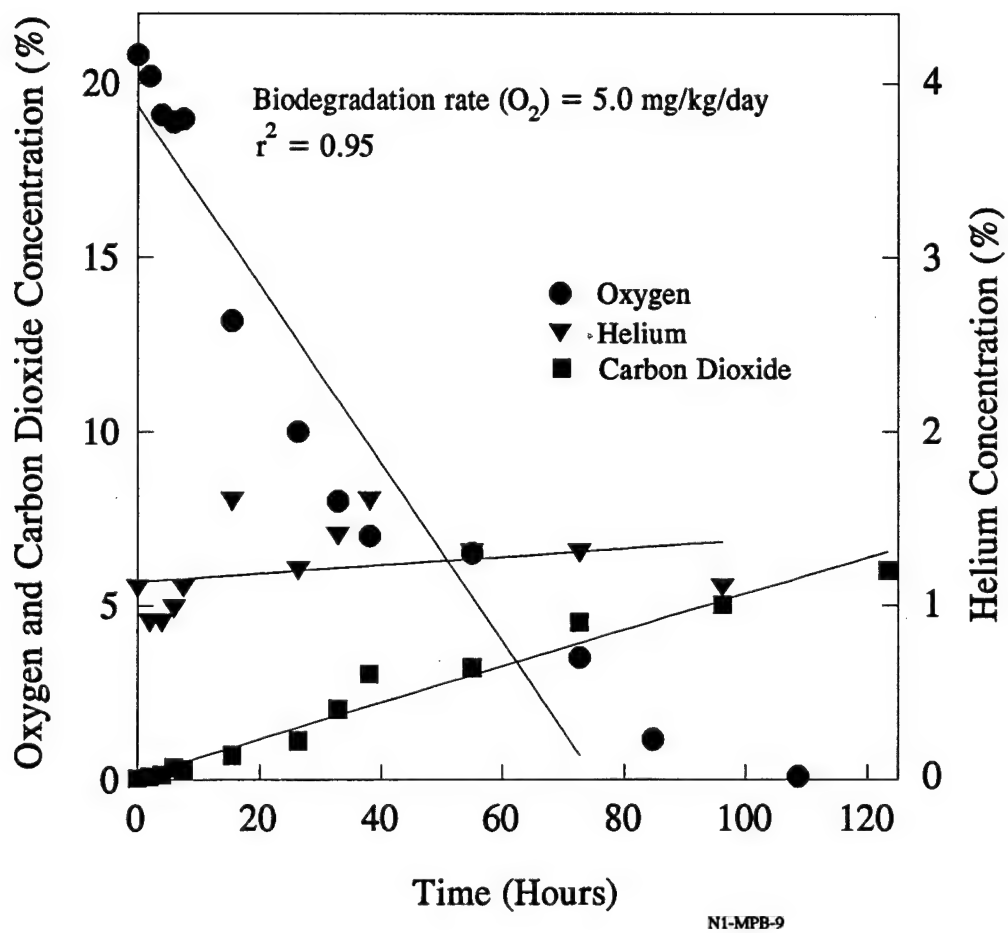


Figure D-4. Oxygen Utilization and Carbon Dioxide Production During the In Situ Respiration Test at Monitoring Point N1-MPB-9.0'

**APPENDIX E**  
**FACILITY 89 SOIL GAS PERMEABILITY DATA**

Table E-1. Results of Soil Gas Permeability Test at Monitoring Point N2-MPA

Time (min)	Pressure ("H <sub>2</sub> O) by Depth			Time (min)	Pressure ("H <sub>2</sub> O) by Depth		
	2.0'	4.5'	7.0'		2.0'	4.5'	7.0'
0	<0	<0	<0	25	0.045	0.32	<0
1	0	0.35	<0	30	0.015	0.34	<0
3	0	0.35	<0	35	0	0.34	<0
4	<0	0.35	<0	45	0	0.35	<0
6	0.002	0.35	<0	55	<0	0.35	<0
9	0.03	0.35	<0	65	<0	0.36	<0
10	0.07	0.35	<0	85	<0	0.35	<0
12	0	0.30	<0	105	0	0.33	<0
15	<0	0.32	<0				
20	<0	0.35	<0				

Table E-2. Results of Soil Gas Permeability Test at Monitoring Point N2-MPB

Time (min)	Pressure ("H <sub>2</sub> O) by Depth			Time (min)	Pressure ("H <sub>2</sub> O) by Depth		
	5.0'	7.5'	10.0'		5.0'	7.5'	10.0'
0	0	0	0	10	0.031	0.030	0.030
0.5	0.020	0.016	0.015	11	0.032	0.030	0.030
1	0.026	0.029	0.029	12	0.035	0.030	0.030
2	0.030	0.029	0.028	13	0.034	0.024	0.020
3	0.030	0.029	0.025	14	0.020	0.011	0.010
4	0.030	0.029	0.025	15	0.024	0.019	0.015
5	0.030	0.029	0.026	16	0.023	0.020	0.019
6	0.031	0.030	0.024	17	0.022	0.021	0.016
7	0.021	0.019	0.015	18	0.025	0.020	0.015
8	0.029	0.026	0.026	19	0.024	0.021	0.017
9	0.029	0.029	0.025	20	0.023	0.019	0.015

**Table E-2. Results of Soil Gas Permeability Test at Monitoring Point N2-MPB (Continued)**

Time (min)	Pressure ("H <sub>2</sub> O) by Depth		
	5.0'	7.5'	10.0'
25	0.025	0.025	0.022
30	0.025	0.025	0.022
35	0.025	0.025	0.020
45	0.029	0.025	0.020
55	0.029	0.029	0.029
65	0.029	0.026	0.026
85	0.019	0.019	0.015
105	0.019	0.019	0.015

Table E-3. Results of Soil Gas Permeability Test at Monitoring Point N2-MPC

Time (min)	Pressure ("H <sub>2</sub> O) by Depth (4.7')	Time (min)	Pressure ("H <sub>2</sub> O) by Depth (9.0')	Time (min)	Pressure ("H <sub>2</sub> O) by Depth (4.7')	Time (min)	Pressure ("H <sub>2</sub> O) by Depth (6.5')	Time (min)	Pressure ("H <sub>2</sub> O) by Depth (9.0')
0	<0	0	<0	0	<0	18:38	<0	19:38	<0
0:3	<0	0:3	<0	0:3	<0	20	<0	20	<0
1:58	<0	2:23	<0	3:07	<0	30	<0	30	<0
3:57	<0	4:24	<0	4:54	<0	40	0	40	<0
5:40	<0	6:06	<0	6:33	<0	50	0	50	<0
7:18	<0	7:38	<0	7:59	<0	60	0	60	<0
8:38	<0	9:10	<0	9:38	<0	80	0	80	<0
10:20	<0	10:47	<0	11:25	<0	100	0	100	<0
12:05	<0	12:50	<0	13:17	<0				
14:10	<0	17:14	<0	17:46	<0				

**APPENDIX F**

**FACILITY 89 IN SITU RESPIRATION TEST DATA**



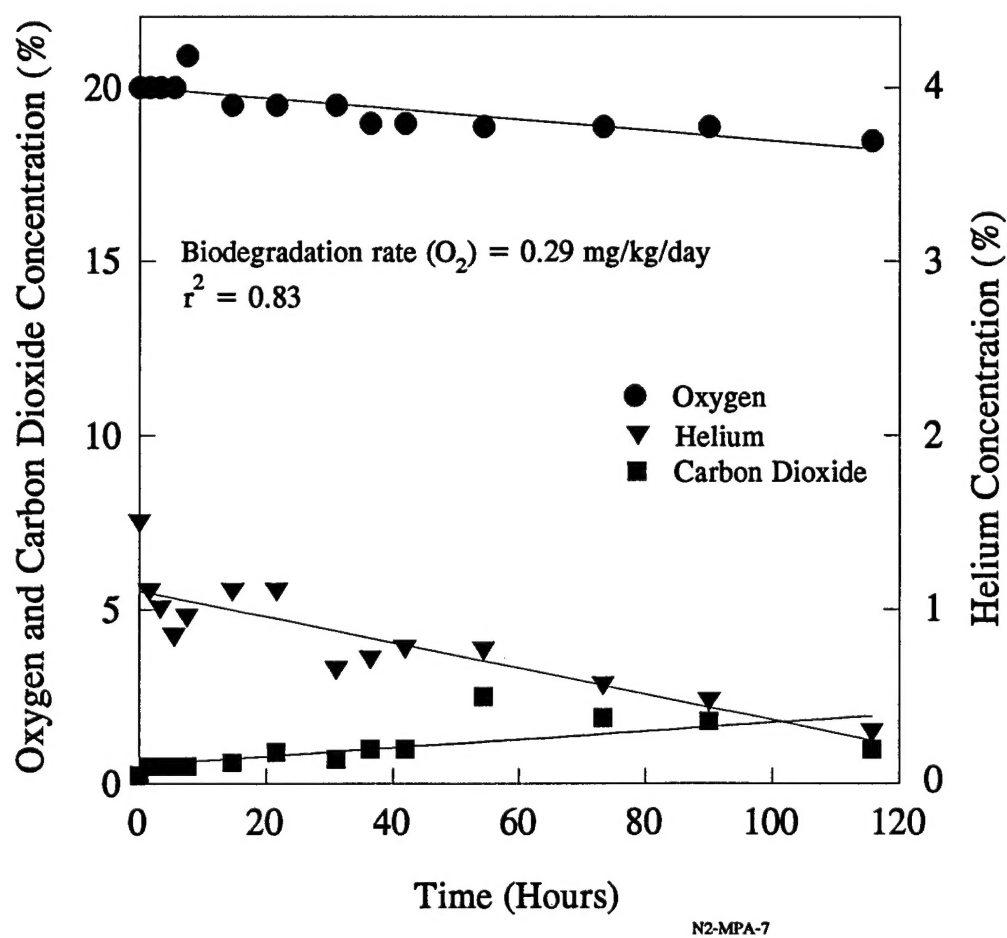


Figure F-1. Oxygen Utilization and Carbon Dioxide Production During the In Situ Respiration Test at Monitoring Point N2-MPA-7.0'

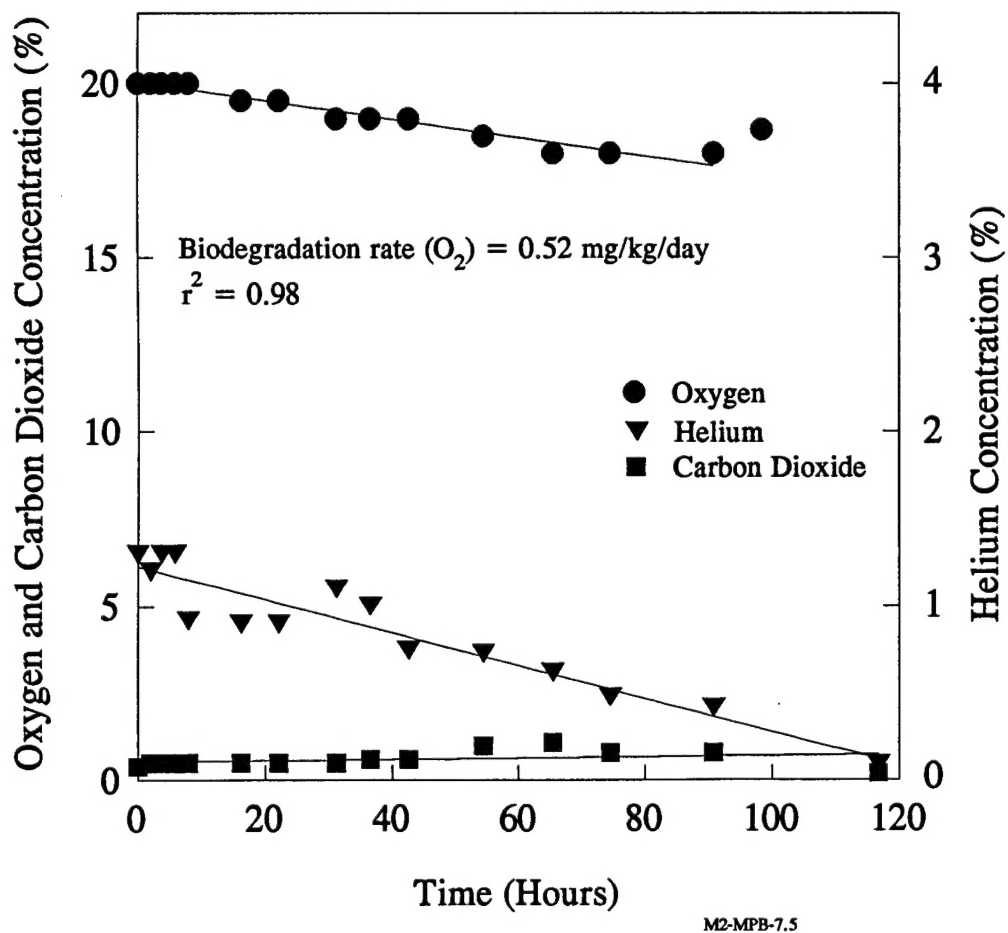


Figure F-2. Oxygen Utilization and Carbon Dioxide Production During the In Situ Respiration Test at Monitoring Point N2-MPB-7.5'

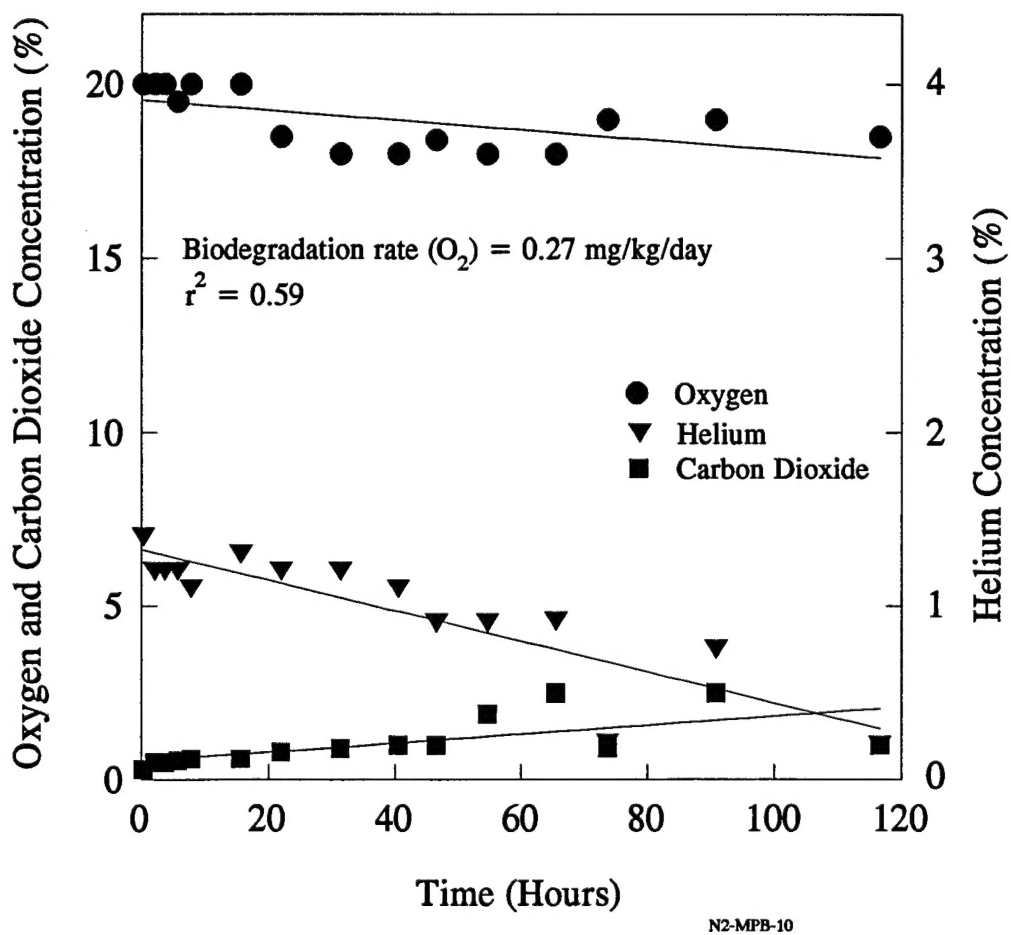


Figure F-3. Oxygen Utilization and Carbon Dioxide Production During the In Situ Respiration Test at Monitoring Point N2-MPB-10.0'

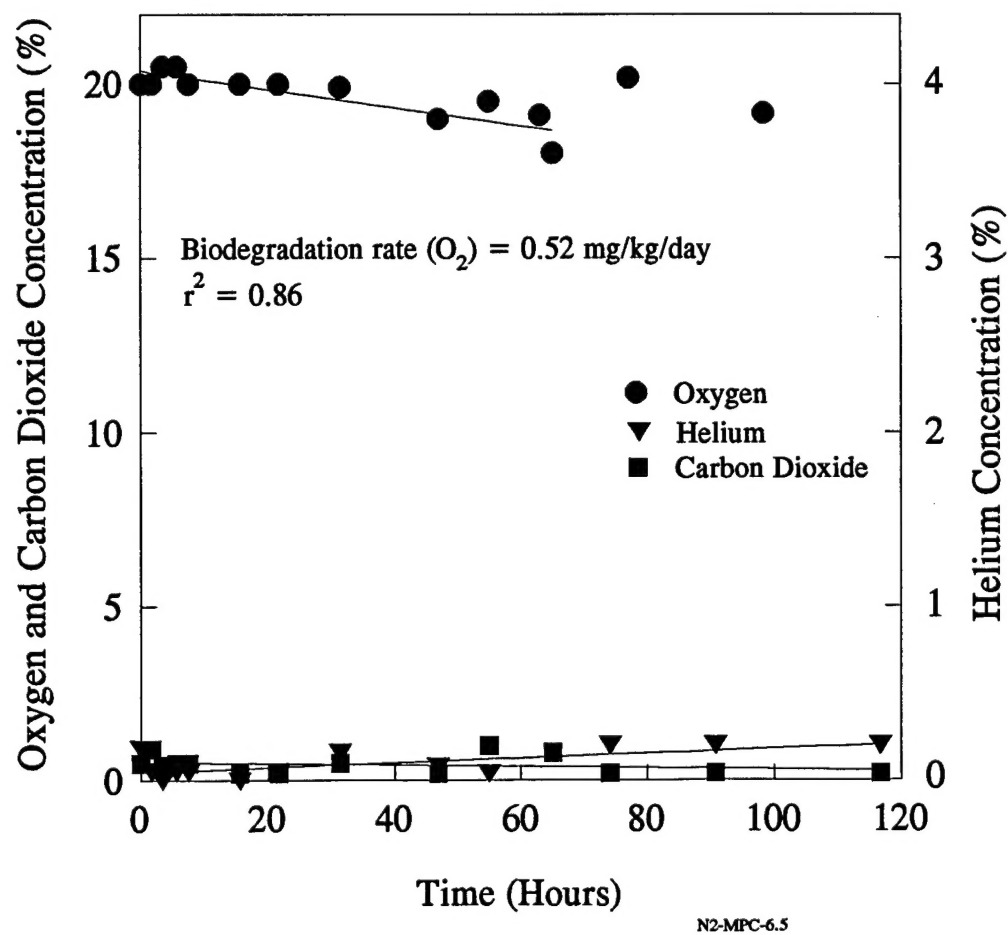


Figure F-4. Oxygen Utilization and Carbon Dioxide Production During the In Situ Respiration Test at Monitoring Point N2-MPC-6.5'